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THE 1992 FORESTRY BMP AUDITS FINAL REPORT

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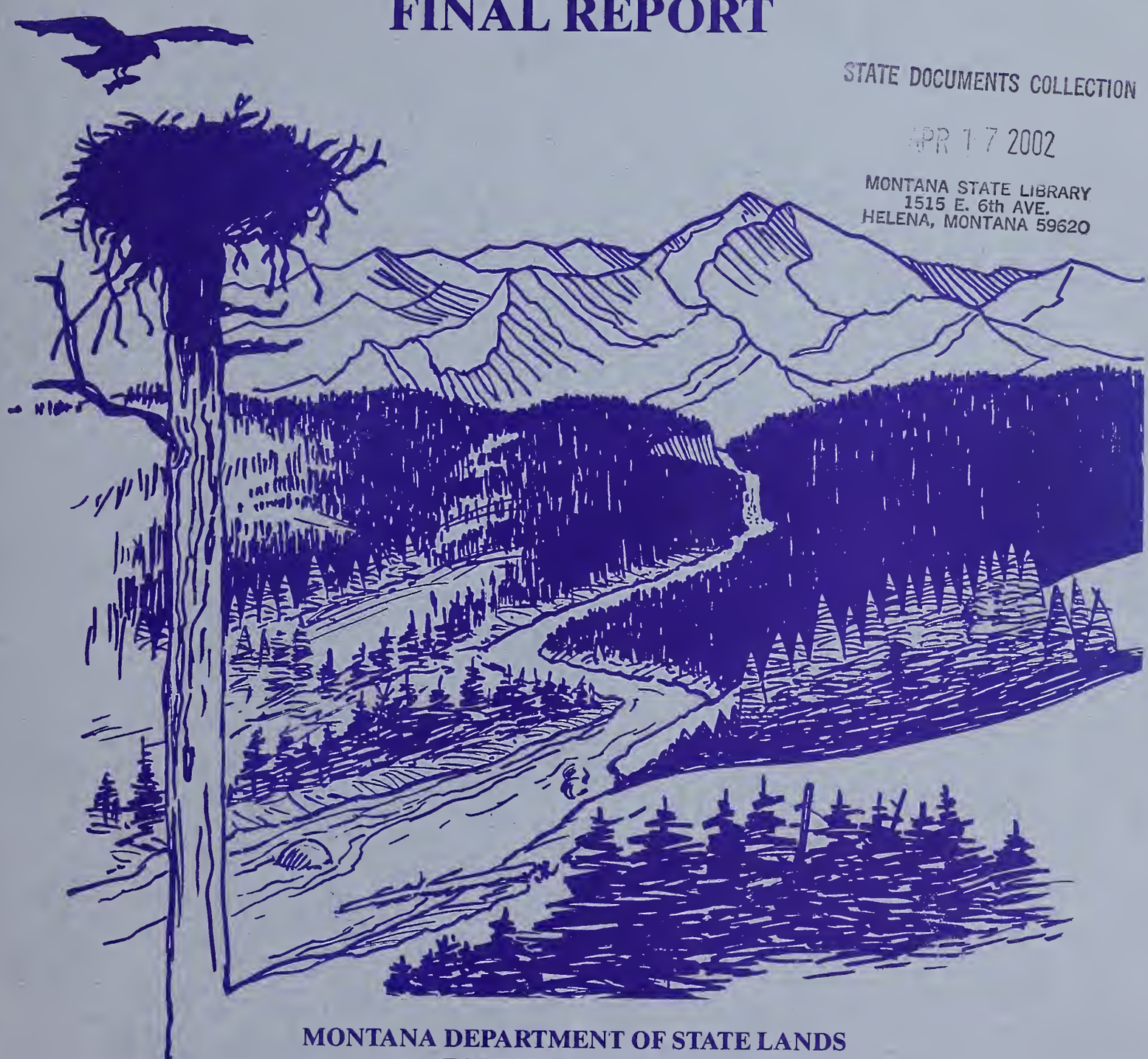

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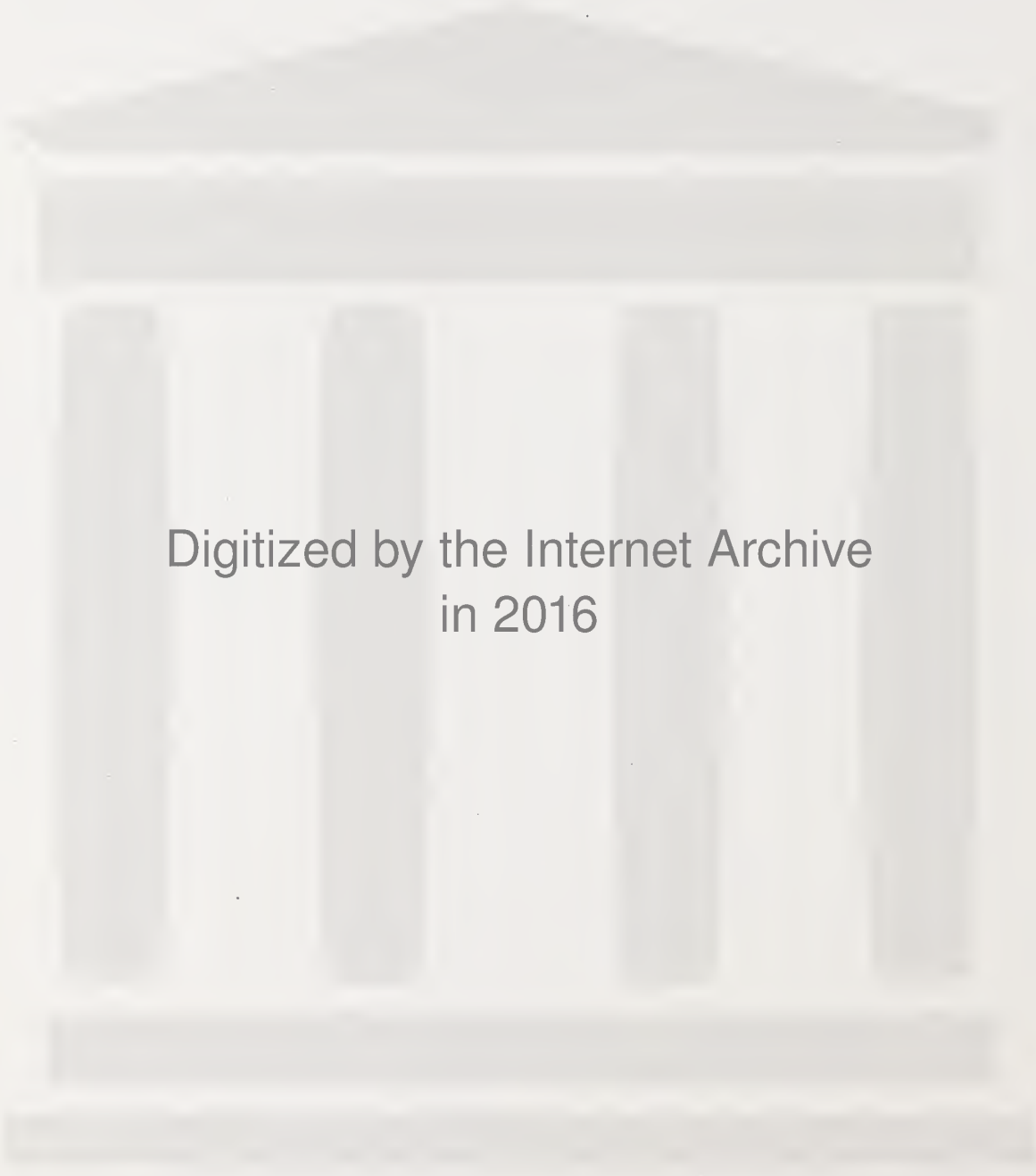
FORESTRY BEST MANAGEMENT PRACTICES

IMPLEMENTATION MONITORING

THE 1992 FORESTRY BMP AUDITS
FINAL REPORT

MONTANA DEPARTMENT OF STATE LANDS
FORESTRY DIVISION
MISSOULA, MONTANA 59801

Report Prepared by Bill Schultz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EXECUTIVE SUMMARY

The Best Management Practice (BMP) audit process is used to evaluate whether BMPs are being applied and whether they are effectively limiting non-point source pollution. In 1991, the Montana Legislature directed the Montana Department of State Lands (DSL) Forestry Division to evaluate forest practices for BMP implementation and report to the EQC before the 1993 legislative session. This report summarizes the findings of Montana's 1992 forestry BMP audits. A similar study and report was completed in 1990.

Three teams conducted the audits. Each audit team was composed of six members: a fisheries biologist, a forester, a hydrologist, a representative of a conservation group, a road engineer, and a soil scientist. DSL used site selection criteria to choose 46 timber harvest sites harvested since 1990. The selection criteria limited the sample to those sites most sensitive to the practices that affect water quality. The audit teams evaluated a maximum of 58 practices at each site, rating application and effectiveness for each BMP on a 5-point scale.

The audit teams evaluated up to 58 practices on 46 sites for a total of 2029 practices rated for BMP application. 87% of the practices rated on all sites met BMP requirements. Because practices vary greatly in their potential impact, the application of nine high risk BMPs was evaluated separately. 72% of the high risk BMPs met application requirements. High risk BMPs are among those most important for protecting watersheds. Most sites--40 of 46--had at least one minor departure from BMP application; 20 of 46 sites had at least one major departure. Non-industrial private lands averaged 11 departures per site, the highest among all ownership groups. The average for all ownership groups was six departures per site.

The audit teams evaluated up to 58 practices on 46 sites for a total of 2029 practices rated for BMP effectiveness. 90% of the practices rated on all sites were judged to provide adequate protection. Of the nine high risk BMPs evaluated on each site, 77% of the practices were rated as providing adequate protection. 32 of the 46 sites audited were producing minor, temporary impacts to the soil and water resource; 17 of 46 sites had at least one major, temporary or minor, prolonged impacts; 5 of the sites had at least one major, prolonged impact. The average number of minor, temporary impacts per site was 2.8; the average number of major, temporary or minor, prolonged impacts per site was 1.4; the average number of major, prolonged impacts per site was 0.4.

On 21 of 36 audit sites, teams noted that a change in stream crossing design would have prevented or reduced sediment discharge. The average length of streambank left unshaded was 28 feet. Ground skidding through a perennial stream occurred on 2 of the 46 sites, although no damage was noted. The average streamside management zone was 53 feet wide. Overall, the wider the SMZ, the fewer impacts in the SMZ from harvest practices. The greatest departure from BMPs, and the most impacts, were associated with road drainage. The text includes a list on pages 26 and 27 of problematic BMPs and BMPs that are usually applied properly.

State lands had a higher rating than other ownership groups in application and effectiveness of BMPs, although the desired number of high hazard sites were not available. Results from Federal (USFS and BLM) and industrial sites were similar and ranked second among the ownership groups. Non-industrial private ranked fourth.

A similar audit was conducted in 1990 and can be compared to the 1992 results. The 1992 audits show improvement in the application and effectiveness of BMPs when compared with the 1990 results.

Comparison of BMP Audit Results - 1992 vs. 1990

	1992	1990
Application of practices that meet or exceed BMP requirements	87%	78%
Application of high risk practices that meet or exceed BMP requirements	72%	53%
Number of sites with at least one major departure in BMP application	20 of 46 (43%)	27 of 44 (61%)
Average number of departures in BMP application, per site	5.6	9
Number of practices providing adequate protection	90%	80%
Number of high risk practices providing adequate protection	77%	58%
Number of sites having at least one major temporary or minor prolonged impact.	17 of 46 (37%)	28 of 44 (64%)
Average number of impacts per site	4.6	8

RECOMMENDATIONS FROM AUDIT TEAM MEMBERS

- Continue the interdisciplinary forestry BMP audits, whether under a non-regulatory or regulatory program. The audit process has been fundamental in educating and making people aware of BMP requirements. Conduct the audits every two years.

- Update the rating form. Adjust for the Streamside Management Act, and for recommended improvements to the rating guide and practices listed.

- Continue educating loggers, landowners, and foresters, concentrating on problem areas documented through BMP audits. Concentrate educational efforts on NIP landowners.

- Actively encourage the sites' owners and logging contractors to attend the audit. The Montana Logging Association and the Montana Wood Products Association will assist DSL in notifying contractors. At a minimum, give contractors a copy of the audit results for their sites.

- The team leader should encourage the landowner and contractor, and if needed in the case of NIP lands, the DSL Service Forester, to develop a remedy for problems noted. An audit team member will assist if necessary, especially to identify problems. Industry groups, such as MLA and MWPA may participate as needed.

- Continue funding volunteer audit team members.

- Institute a similar BMP audit process for other land uses, including mining, livestock grazing, agriculture and subdivision development.

INTRODUCTION

The forest lands of Montana form the headwaters of several of major river basins and produce large quantities of high quality water. The high quality water nurtures some of the west's best fisheries, and provides water for irrigation and livestock, and for domestic, recreational and industrial purposes. These same lands supply the logs that sustain the forest products industry, an important component of Montana's economy. All products from Montana's 22.5 million acres of forest land contribute in an essential manner to Montana's economy and way of life.

Montana's water quality protection program for forestry involves a combination of regulatory and non-regulatory approaches. Since the 1970's, voluntary Forestry Best Management Practices have provided guidance as minimum water quality protection standards for forestry operations.

The BMPs, if properly designed and and effectively applied, can limit non-point source pollution--the kind of diffuse pollution that forestry operations often produce, such as sediment from a road or timber harvest. The BMP audit process is used to evaluate whether BMPs are being applied and whether they are effectively limiting non-point source pollution.

Concern over the impacts of forest management on the State's watersheds prompted the 1987 Montana Legislature to pass House Joint Resolution 49. This resolution directed the Montana Environmental Quality Council (EQC) to study "how current forest management practices are affecting watersheds in Montana." The EQC established a BMP technical committee that revised Montana's forestry BMPs, as a result of HJR-49, in 1989.

Prior to 1990, forestry water quality was addressed through a voluntary approach. In 1990, the legislature enacted the BMP Notification Law (76-13-101 MCA) which requires private landowners who plan to harvest timber to notify the state of their plans. Under this law, forestry BMP information is sent to landowners. Implementation of practices is voluntary. DSL Service Foresters review a limited number of high risk sites prior to timber harvest. Nearly all sites on private land reviewed by these audits were subject to the BMP Notification law.

Since October 1991, the Streamside Management Zone Law (77-5-301 MCA) regulates forestry practices along streams. This law prohibits certain forest practices along stream channels. These BMP audits did not evaluate compliance with the SMZ law because most operations were completed prior to the effective date of the law.

Forestry BMP audits have been conducted previously in Montana. As part of HJR-49, audit teams conducted the first State-wide assessment of forest practices for BMPs during the summer of 1988 (Zackheim, 1988). In 1989, the University of Montana, under the Flathead Basin Water Quality and Fisheries Cooperative, audited more sites for BMPs in the Flathead River drainage (Ehinger and Potts, 1990). The Montana Legislature directed DSL to conduct another round of statewide BMP audits in 1990 (Schultz, 1990).

In 1991, the Montana Legislature directed the Montana Department of State Lands (DSL) Forestry Division to once again evaluate forest practices for BMP implementation, and report to the EQC before the 1993 legislative session. This report summarizes the findings of Montana's 1992 forestry BMP audits.

The BMP audit process, which the EPA calls BMP implementation monitoring, is a widely used means of evaluating forest practices. Implementation monitoring is a surrogate for water quality monitoring, a more quantitative approach. Water quality monitoring is a long-term and expensive endeavor. Water quality varies naturally, due to variable geology, land forms, soils, and climatic events. Due to this variability, investigators have to collect large numbers of samples at the right time and over a long period of time to accurately characterize water quality.

Investigators use qualitative implementation audits to find out if BMPs are being applied and whether they are controlling erosion; they can use quantitative water quality monitoring to determine if BMPs are protecting beneficial water uses. Since BMPs are recognized by State and federal legislation as a method to control non-point source pollution, it makes sense to check the application and effectiveness of BMPs as part of a such a program. States are increasingly relying on qualitative surveys, using interdisciplinary teams to assess forest practices on-site, to monitor their silvicultural non-point source control programs (NCASI, 1988). California, Idaho, Oregon, Utah, Minnesota, Washington, South Carolina, and Florida all use a similar qualitative approach to assess the control of non-point source pollution.

METHODS

The 1992 audits were conducted with the same objectives and criteria as the 1990 audits in order to produce comparable results.

The objectives for the 1990 and 1992 BMP field audits were to:

1. Determine if BMPs are being applied on timber harvest operations.

2. Evaluate the general effectiveness of BMPs in protecting soil and water resources.

3. Provide information on the need to revise, clarify, or strengthen BMPs.

4. Provide information to focus future study efforts by identifying subjects and geographic areas in need of further investigation.

DSL sought a broad range of participation in planning the 1990 audits. Since the 1992 audits were to be conducted with the same objectives, criteria, and methods, less planning was necessary for the 1992 audits.

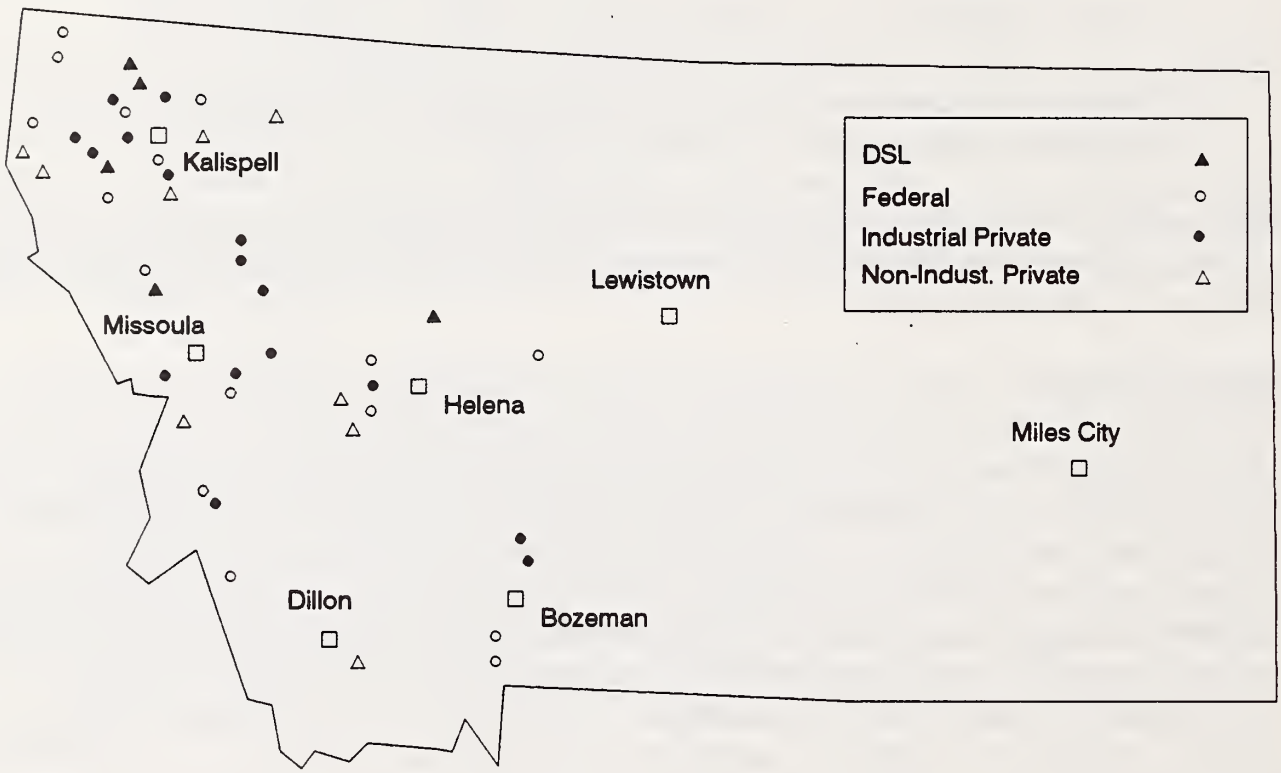
The Audit Teams

DSL designated three audit teams--one for the northwest, one for the west central, and one for the southwest and east parts of the State. Each team was composed of six members--a fisheries biologist, a forester, a hydrologist, a representative of a conservation group, a road engineer, and a soil scientist. A member of each audit team was assigned to lead the team. The team leader was responsible for filling out the consensus rating form and for overseeing the logistics of the team. Team members were employees of federal and state agencies, private industry, and independent consultants. The legislature provided funds to pay volunteer members who could not participate as a part of their regular job. Continuity in team membership was excellent. Sixteen of the 18 team members from the 1990 audits participated in the 1992 audits. DSL named an alternate for each member in order to ensure a full range of interdisciplinary participation at each site. Most of the alternates had also participated in the 1990 audits. See Appendix A for a complete list of team members.

The Study Area

The Department limited the study area to the western half of the State, where a vast majority of the timber harvest operations in Montana occur. This is consistent with the 1990 audits. The most easterly sites selected were in the White Sulphur Springs area.

MAP # 1. GEOGRAPHIC DISTRIBUTION OF AUDIT SITES



Site Selection

The criteria for selecting sites was identical to the 1990 audits, with an updated timeframe. The purpose in defining the criteria was to concentrate on sites that were more likely to have potential for water quality impacts. The selection criteria limited the sample to only those timber harvest sites most sensitive to the practices that affect water quality. Selecting the sites was the responsibility of DSL.

SITE SELECTION CRITERIA

The initial criteria for selection were:

- Sites were selected from areas with timber harvested in 1990, 1991, or 1992. Priority was given to most recently harvested sites.

- A portion of the sale needed to be located within 200 feet of a stream (see BMP definition).

- Minimum size for harvest units to be included in the audit process was 5 acres. Minimum timber removal was 7,000 board feet per acre. Some flexibility was allowed if smaller or low volume harvest met other criteria.

- The distribution of audit sites reflected the distribution of timber harvest in Montana, geographically, and by owner.

- Sites were classified into four land ownership classes--nonindustrial private, industrial private, federal, and state. The number of sites per ownership group was to be proportional to the volume of timber each group harvested in 1990, the latest complete reporting period. A minimum of five sites per ownership class was audited.

For sites that met the initial criteria, DSL made further stratification:

- Sites with road construction or reconstruction and slash disposal completed were given first priority.

- Sites with road construction or reconstruction but slash disposal not completed were given second priority.

- Sites with slash disposal completed but no road construction were given third priority.

- Sites were further stratified by erosion hazard. Two-thirds of the audits were located on high erosion hazard sites. One-third were to be located on low to medium erosion hazard sites. This stratification was subject to availability of sites in the various hazard groups.

  Erosion hazard was determined as a function of slope steepness and erosivity based on geologic parent material and soil texture. Erosion hazard was stratified by ownership class so that a disproportionate number of high hazard sites did not fall in any one ownership class. Erosion hazard was determined using an erosion hazard matrix developed through the Montana Riparian Association. See Appendix B. Timber harvest in riparian zones was categorized as high hazard.

The number of days that team members would be able to conduct audits limited DSL to choosing 46 sites for the teams to visit. The maximum time commitment for audit team members was set at 10 days, since a longer commitment would likely jeopardize the ability of individuals to participate. On most days, teams could audit a maximum of two sites. See Appendix E for the list of the sites. The four ownership groups and number of sites audited were:

OWNERSHIP GROUP	NUMBER OF SITES AUDITED		
	1990	1992	
Federal (USFS and BLM)	16	16	(14--USFS, 2--BLM)
Industrial Private	16	16	
Non-Industrial Private	7	9	
Dept. of State Lands	5	5	
TOTAL	44	46	

The goal for the audits was to have two-thirds of the sites in the "high hazard" category, as explained in the criteria for selecting sites. In order to meet the high hazard criteria, a site had either to rank high in a risk matrix that considers slope steepness, soil erodibility, and type of operation, or to be in a riparian zone. See Appendix B. Table 1 shows the percent of audited sites that met the high hazard criteria, whether included by matrix, riparian, or both. Just over three-quarters of the total sites audited were high hazard. This is similar to the number of high hazard sites in 1990. Due to lack of available sites, the state ownership group did not meet the criteria for two-thirds high hazard sites. The Department of State Lands has harvested timber on very few high hazard sites in the time period sampled.

Table 1

Percent of Sites Meeting High Hazard Criteria

Ownership Group	Number of Sites	Matrix	Riparian	Matrix, Riparian or both
Federal	16	75%	69%	88%
Industrial	16	69%	56%	81%
NIP	9	67%	33%	44%
State	9	40%	0%	40%
All Sites	46	67%	50%	76%

Members of all the ownership groups provided excellent cooperation as DSL selected sites. Industry and government supplied all information requested, and in most cases, in a very timely manner. DSL acquired the information about recent timber sales as follows: The affected National Forests and BLM searched their recent timber sales for sites that met some or all of the criteria. DSL finished refining the search where needed. For non-industrial and industrial private lands, DSL searched Hazard Reduction Agreements and Master Hazard Reduction Agreements for sites that met the criteria. DSL searched its own timber sale accounting program for sites that met the criteria.

DSL listed sites that met the criteria, by region within ownership groups. Sites to be audited were selected from the pool of suitable sites within each ownership group. Only those sites with potential to impair water quality were judged to be suitable.

In the case of non-industrial private lands, DSL contacted landowners for permission to visit their lands. Two landowners denied the audit teams access. Alternate sites were selected. Access to the other ownership groups was not an issue.

The size of audited sites varied greatly. See Table 2 for information on size of harvest units evaluated by ownership group. On very large sites, time did not allow the teams to review every acre of the site. Teams concentrated on areas with the greatest potential for problems.

Table 2

Size of Harvest Units Evaluated By Ownership

Ownership Group	Number of Sites	Average Unit Size (Ac.)	Maximum Unit Size (Ac.)	Minimum Unit Size (Ac.)
Federal	16	24	39	7
Industrial	16	125	400	32
NIP	9	102	300	10
State	5	34	90	5
All Sites	46	75	400	5

Sample Size

Because the total number of cutting units in the State is not known, it is not possible to say what percentage of them the 46 sites represent. It is a representative sample of logging operations conducted in Montana since 1990 that meet the selection criteria. The selection criteria limited the sample to only those timber harvest sites most sensitive to the practices that affect water quality. The results are indicative of conditions for sites with potential to impair water quality. The results do not represent a sample of all timber harvest operations in Montana. In 1990, the 44 sites represented approximately 1% of the total volume harvested in the state for the study period.

The Rating Form

The audit teams used a rating form similar to that of previous audits. See Appendix C for a copy of the form. The form was revised for the 1990 BMP field audits to reflect the changes HJR-49 made to forestry BMPs. The guide for rating application was the same as used in the 1988 audit. The guide for effectiveness changed the definition for a "2" rating from major and temporary to include minor and prolonged. The audit teams evaluated a maximum of 58 practices at each site, rating application and effectiveness for each on a 5-point scale.

The audit team rated practices for BMPs by noting if the BMP, first, was applicable to the site, and then if so, whether it was applied correctly and in the proper locations. Lack of adequate application or misapplication are departures from BMPs. The rating guide for application of BMPs was:

5 - Operation exceeds requirements of BMP.
4 - Operation meets requirements of BMP.
3 - Minor departure from intent of BMP.
2 - Major departure from intent of BMP.
1 - Gross neglect of BMP.

The following description of the rating guide is adapted from Ehinger & Potts, 1990. Ratings of 5 and 4 are self-explanatory. The 3 rating, minor departure, applies to departures of small magnitude distributed over a localized area, or over a larger area where potential for impact is low. The 2 rating, major departure, applies to departures of large magnitude or BMPs being repeatedly neglected. The 1 rating, gross neglect, applies where risks to soil and water resources were obvious and yet there was no evidence indicating that operators had applied BMPs to protect these resources.

The effectiveness rating answered questions concerning impacts. For example "has the application or misapplication of a particular forest practice increased the likelihood of, or actual occurrence of, surface sediment in the stream channels?" Lack of effectiveness results in impacts. The rating guide for effectiveness was:

5 - Improved protection of soil and water resources over pre-project condition.
4 - Adequate protection of soil and water resources.
3 - Minor and temporary impacts on soil and water resources.
2 - Major and temporary, or minor and prolonged, impacts on soil and water resources.
1 - Major and prolonged impacts on soil and water resources.

The work group defined these terms prior to the 1990 audits to help the audit teams use them consistently:

Adequate - Small amount of material eroded; material does not reach draws, channels, or floodplain.

Minor - Some material erodes and is delivered to draws but not to stream.

Major - Material erodes and is delivered to stream or annual floodplain.

Temporary - Impacts lasting one year or less; no more than one runoff season.

Prolonged - Impacts lasting more than one year.

The audit teams used a flow chart to help rate application and effectiveness, and, again, to keep the rating consistent. See Appendix D.

Audit Site Inspections

The first audit site inspection served as a calibration audit for the teams. Since most team members participated in previous audits, this session served as a refresher. The goal was to have the audit teams establish a consistent method of rating that could carry through the rest of the audits. Team members and alternates met for several hours of classroom instruction on the BMP audit process, and then evaluated the first audit site in the field. The team members shared their results with the other members, and identified and discussed their differences and ways to be consistent.

The teams conducted the audits July through September of 1992. The field routine consisted of meeting at a central location in the morning of each audit day. Teams traveled to the audit site. On site, the team leader provided maps and audit forms. Usually a representative of the landowner briefed the team by giving background information on the silvicultural prescription, time of operation, and associated practices. Team members walked the site, reviewing potential impact areas such as roads, streams, streamside management zones (SMZs), skid trails and firelines. Teams typically spent about two hours inspecting each site.

After finishing the inspection, the team gathered to discuss the rating while still on site. The team leader was charged with leading the discussion and recording the consensus rating for each item on the rating form. Each team completed a single rating form for each site. For ratings where the team could not reach consensus, the team took a vote and recorded the rating with the most votes. The team leader noted dissenting values in the Comments section. Teams almost always reached consensus. Twenty-five individual ratings came to a vote. Twenty-two of these were on sites reviewed by the Southwest Team.

Limitations of the Audit Methods (in part, adapted from Idaho DHW, 1989.)

In analyzing the audit results, readers need to consider the limitations of the techniques used in the audit. The audit technique consisted of a one-time field inspection and assessment. This approach documents erosion and sedimentation problems which occur in the first or second year after harvest. This is generally the critical period for erosion associated with timber harvests. Some practices conducted during harvest cannot easily be evaluated in post-harvest audits. The assessment was based on visual appraisal of practices and impacts to surface soils and streams. The results are a snapshot-in-time of the practices and subsequent impacts. They do not necessarily reflect future impacts.

Sites were split among three teams. There are likely some differences in how the teams may have rated individual items. Lack of consistency is probably not a big problem, based on discussion with other teams and through overlap of team members on some audits, but it should not be overlooked.

Also, auditors may rate several practices connected with one action. In some cases, one action may result in more than one rating. For example, if a skidder operates extensively in the Streamside Management Zone, the practice may rate poorly under both "Adequate SMZ Maintained" and "Equipment Operation Minimized in SMZ." Even given these limitations, the BMP audit process is an effective way to promote BMPs and encourage landowners and operators to protect water quality on managed forests.

RESULTS

The results of the 1992 BMP field audits are presented in several categories, including application of BMPs, effectiveness of BMPs, supplemental questions on the audit form, and comparison of the 1992 results with previous audit results.

There are several ways to analyze and summarize the qualitative data generated by this study. One method is simply to look at what percent of the practices audited for BMPs fell into each rating category, by ownership group. This information is presented, for application and effectiveness of BMPs respectively, in Tables 3 and 6. While this is useful information for some purposes--including documenting problem BMP areas and comparing these results with other audits--readers should not base their conclusions on these simple percentage ratings. Appendix F tabulates how the ownership groups complied with each BMP.

All the practices evaluated in the audits can have an effect on water quality, but vary greatly in their potential impact. For example, BMPs in the "Road Planning and Location" section do not have as direct a potential impact on water quality as the practices in "Providing Adequate Road Surface Drainage" or "Adequate SMZ Maintained."

High Risk BMPs

Focusing on the simple percentages will not give a clear picture of how well or poorly Montana's watersheds are being protected. Even a low percentage of misapplied BMPs can still result in serious impacts. To provide several perspectives, the data has been analyzed in different ways. In particular, a subset of nine high risk BMPs has been analyzed separately. These nine high risk BMPs are among the most important for protecting Montana's watersheds. The nine high risk BMPs are:

BMP NUMBER	PRACTICE DESCRIPTION
I.C.1	Provide adequate road surface drainage.
I.C.6	Route road drainage through SMZ.
I.D.2	Stabilize erodible soils.
I.E.2	Erosion control features functional.
II.A.5	Skid trail design avoids concentrating runoff.
II.B.1	Adequate SMZ maintained.
III.C.3	Prevent erosion of culvert and bridge fills.
II.C.2a	Adequate drainage for temporary roads, skid trails, fire lines.
II.D.9	Limit water quality impacts of prescribed fire.

The results for application and effectiveness of the nine high risk BMPs is presented in Tables 4 and 7, and Figure 1. Tables 5 and 8 summarize the data on a site basis, displaying the percent of sites with departures or impacts and the average number of departures or impacts per site.

Some Practices Not Rated

The number of practices rated represents 76% of the total possible number of practices. Some BMPs did not apply to a site: some sites did not have stream crossings; most sites did not have borrow pits; in several instances, slash disposal and site preparation had not been completed; the Hazardous Substances section of BMPs does not apply on most sites. In other cases, the audit team could not rate the BMP at the time of the audit--BMPs having to do with timing of operations during the harvest cannot be judged post-harvest.

Application of BMPs

The application rating measures whether the BMP was applied, whether it was applied correctly, and whether it was applied in the proper locations. See page 14 for further explanation of the application rating. The audit teams evaluated a total of 2029 practices to assess how landowners and operators applied BMPs. Table 3 lists the percent of practices that fell in each application rating category, by ownership group. Rather than focusing on simple analysis, the reader should refer to other tables (Tables 4, 5, 7 and 8) that better indicate how well Montana's watersheds are being protected.

Table 3

Application of BMPs to All Rated Practices
by Ownership Group and Rating Category

		Percent (%) Practices Rated As			
Ownership Group	# Practices Rated	Meet or exceed	Minor departures	Major departures	Gross neglect
Federal	734	88%	9%	2%	<1%
Industrial	738	91%	7%	2%	0%
NIP	339	70%	13%	10%	0%
State	738	97%	3%	0%	0%
All Sites	2029	87%	8%	3%	1%

Table 4 shows the BMP application for the nine high risk BMPs that were evaluated separately (see page 17). The percent of practices with departures is higher for the high risk group (Table 4) than for all audited practices (Table 3), as shown in Figure 1.

Table 4

Application of High Risk BMPs
by Ownership Group and Rating Category

		Percent (%) Practices Rated As			
Ownership Group	# Practices Audited	Meet or exceed	Minor departures	Major departures	Gross neglect
Federal	129	71%	21%	0%	1%
Industrial	135	75%	10%	0%	0%
NIP	64	50%	16%	20%	14%
State	40	50%	5%	0%	0%
All Sites	368	72%	17%	8%	3%

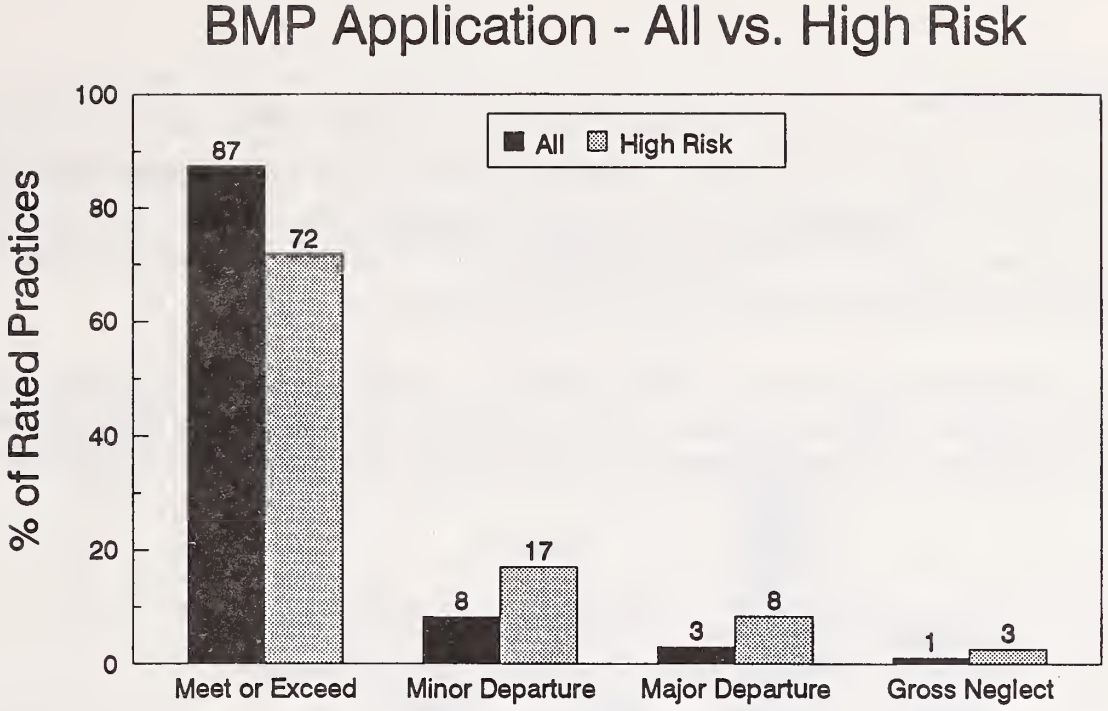


Figure 1.

Table 5 shows what percentage of sites departed from BMPs, and the average number of departures per site. The average number of departures per site includes all the sites, not just the sites with departures. Table 5 shows that most sites 87% -- 40 of 46 -- had at least one minor departure. It also shows that 43% -- 20 of 46 -- sites have at least one major departure in BMP application.

Table 5

Audit Sites with Departures from BMP Application
and Average Number of Departures per Site

		Percent (%) of sites with departures			# of departures/total # of sites = ave. #/site		
Ownership Group	Total # of sites	Minor	Major	Gross	Minor	Major	Gross
Federal	16	100%	44%	6%	4.0	1.0	0.1
Industrial	16	75%	38%	0%	3.3	0.7	0
NIP	9	100%	78%	44%	5.0	4.0	2.4
State	5	60%	0%	0%	1.4	0	0
All Sites	46	87%	43%	11%	3.7	1.4	0.5

Effectiveness of BMPs

The effectiveness rating evaluates how well BMPs protected soil and water resources. See page 15 for further explanation of the effectiveness rating. The audit teams evaluated a total of 2029 practices to see how effective the BMPs were. Table 6 provides a summary of the effectiveness of all practices audited, by ownership group.

As with the corresponding table for BMP application (Table 3), this information should be used with discretion. While simple percentage ratings may be relatively high for the category Adequate Protection, poor effectiveness of a single BMP may still result in impacts.

Table 6

Effectiveness of BMPs for All Rated Practices
by Ownership Group and Rating Category

		Percent (%) Practices Rated As			
Ownership Group	Number of Practices Rated	Adequate Protection	Minor/Temp Impacts	Major/Temp, Minor/ Prolong	Major/ Prolong
Federal	734	92%	5%	2%	<1%
Industrial	738	92%	6%	2%	0%
NIP	339	73%	12%	11%	0%
State	218	99%	1%	0%	0%
All Sites	2029	90%	6%	3%	1%

Figure 2 presents the percent of practices audited that are contributing to impacts by ownership group. This figure shows differences among ownership groups in effectiveness of their BMP implementation.

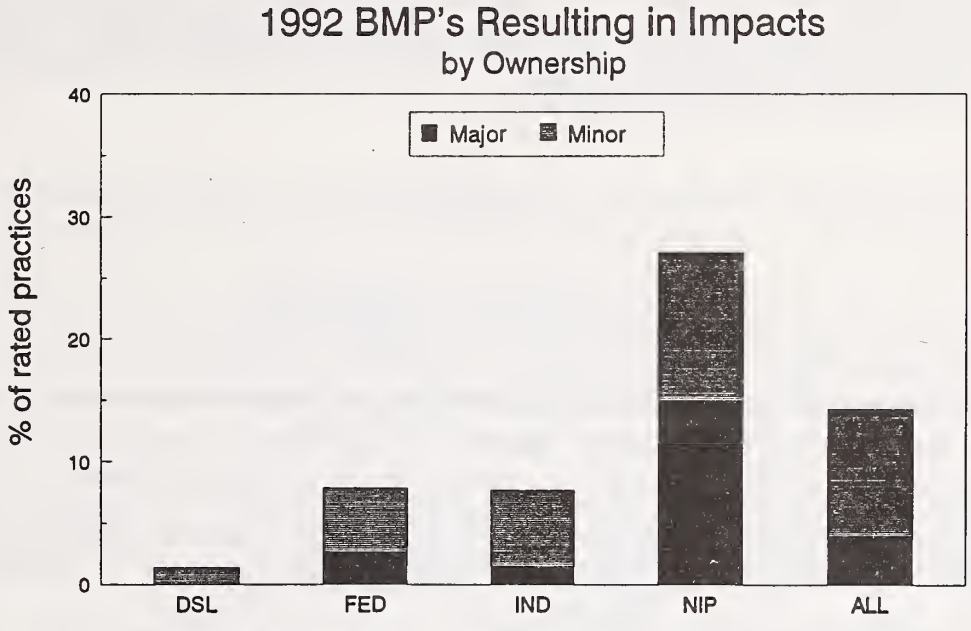


Figure 2. Major impacts are practices with an effectiveness rating < 3. Minor impacts are practices with effectivness rating of 3.

Table 7 shows the effectiveness of the nine high risk BMPs listed on pages 17. The percent of practices providing adequate protection is lower for the high risk BMPs than for the total BMP results presented in Table 6. The percent of practices resulting in impacts is higher for the high risk BMPs than for practices in general.

Table 7

Effectiveness of High Risk BMPs
by Ownership Group and Rating Category

		Percent (%) Practices Rated As			
Ownership Group	Number of Practices Audited	Adequate Protection	Minor/Temp Impacts	Major/Temp, Minor/ Prolong	Major/ Prolong
Federal	129	83%	8%	8%	1%
Industrial	135	76%	19%	5%	0%
NIP	64	56%	13%	23%	8%
State	40	95%	5%	0%	0%
All Sites	368	77%	12%	9%	2%

Table 8 lists the percentage of sites with impacts and average number of impacts per site. This table shows that 74% of the sites audited were producing at least minor, temporary impacts--at an average of 2.8 per site. 37% of all sites were producing major, temporary impacts--an average of 1.4 per site. This analysis illustrates that, while the percent of practices rated as providing adequate protection may be quite high (90%), impacts were still occurring on a majority of the sites audited.

Table 8

Audit Sites with Impacts and
Average Number of Impacts per Site

		Percent (%) of sites with impacts			# of impacts/total # of sites = ave. #/site		
Ownership Group	total # of sites	Minor/ Temp	Major/Temp, Minor/ Prolong	Major/ Prolong	Minor/ Temp	Major/Temp, Minor/ Prolong	Major/ Prolong
Federal	16	75%	38%	6%	2.4	1.1	0.2
Industrial	16	75%	38%	0%	2.9	0.7	0
NIP	9	67%	67%	33%	4.6	4.0	1.7
State	5	40%	0%	0%	0.6	0	0.0
All Sites	46	70%	37%	10%	2.8	1.4	0.4

Supplemental questions

The audit teams answered seven supplemental questions to address EPA concerns about the adequacy of Montana's BMPs. The supplemental questions and answers to them are:

1. When roads were closed, or after use of temporary roads, were culverts or stream crossing structures removed and the stream channel reformed to its pre-road configuration?

   This question applied to only 7 of the 46 sites audited. No problems were noted on 5 of the 7. One site needed grass seed. One site needed additional water bars.

2. What condition were temporary roads left in after their use?

   Temporary roads were treated with a variety of measures, including kelly humps, water-bars, seeded with grass, or obliterated. In one instance, the audit team noted that the road needed to be seeded with grass in addition to the water bars that had been installed.

3. Would a change in stream crossing design have prevented any observed sediment discharge problems attributable to the crossings? Explain.

   This question applied to 36 of the sites evaluated. On 21 of the 36 applicable sites (58%), teams noted that, yes, a change in crossing design would have prevented or reduced sediment discharge. Recommendations include installing slash filter windrows; adjusting the grade of the road so the crossing does not concentrate road surface runoff; installing drain dips and ditch relief culverts on crossing approaches; seeding with grass; constructing cut slopes at stable angles; rock armoring the inlet of the culvert; using adequate size and length culvert; and, avoiding the crossing altogether.

4. Describe the width and depth of the active channel for the stream(s) associated with this sale.

   Most audits were conducted along small streams in upland areas. Most of these streams were not fisheries streams, but were important to downstream water quality. The average dimensions of the stream channels on the audited sites was 5.8 feet wide and 0.8 feet deep. Stream width ranged from 1 to 50 feet. Depth ranged from 0.25 to 3.0 feet deep. These figures are similar to the 1990 results.

5. What length of streambank was left unshaded due to timber harvest and vegetation removal in the streamside zone?

Ownership Group	Maximum Length in feet	Average Length in feet
Federal	500	31
Industrial	250	24
NIP	200	57
State	0	0
All Sites	500	28

6. Did ground skidding take place through any perennial streams?

   Ground skidding through a perennial stream occurred on 2 of the 46 sites audited, or 4%. In one case the stream was 3 feet wide and approximately 10 logs were pulled across the stream. No impacts were noted. In the other case, the stream was 10 feet wide and logs were skidded in the winter over a snow bridge. No impacts were noted.

7. Did timber harvest planning include considerations for watershed condition and cumulative effects of multiple timber management activities on water yield and sediment production?

   The audit teams judged landowners to have considered cumulative effects if they had assessed at least one of the following: water yield, sediment yield, or the total amount of timber harvest that had occurred in the basin, compared to the size of the basin. On two sites, the audit teams did not have enough information to judge whether cumulative effects had been considered or not.

Ownership Group	Sites Where Landowners Assessed Cumulative Effects
Federal	13 of 15 = 87%
Industrial	2 of 16 = 13%
NIP	0 of 8 = 0%
State	5 of 5 = 100%
All Sites	20 of 44 = 45% (2 sites - insufficient information)

DISCUSSION

Table 3 indicates that 87% of the practices applied on all sites met or exceeded BMP standards. This type of analysis does not accurately represent the impact that practices have had on the audited sites. Not all practices are equally important for protecting water quality. 72% high risk BMPs, as listed in Table 4, met BMP requirements.

23% of the high risk BMPs resulted in impacts, as shown in Table 7. Table 8 indicates that 70% of the audited sites (32 out of 46) produced minor, temporary impacts and 37% (17 out of 46) produced either major, temporary or minor, prolonged impacts. Five of the sites produced major, prolonged impacts. These impacts could have been prevented if landowners and operators had properly applied BMPs.

As was true for the 1990 audits, the results of the 1992 audits show that the greatest departure from BMPs, and the most impacts, were associated with road drainage. Inadequate streamside management zones, poor skid trail design, and prescribed fire in poor locations also resulted in a large number of deficiencies in application and impacts.

The list that follows is of individual BMPs that most often are not properly applied or result in impacts, ranked in order, by the sum of departures and impacts. Ranking from the 1990 audit is listed in parenthesis. (-) indicates not frequent enough to be in top 18 in 1990.

1992	1990	PRACTICE DESCRIPTION	PRACTICE #
1.	(6.)	Adequate drainage for temporary roads, skid trails, and fire lines	(IIC2a)
2.	(3.)	Route road surface drainage through an SMZ	(IC6)
3.	(1.)	Provide adequate road surface drainage	(IC1)
4.	(11.)	Adequate SMZ maintained	(IIB1)
5.	(9.)	Skid trail design avoids concentrating runoff	(IIA5)
6.	(16.)	Limit water quality impacts of prescribed fire	(IID9)
7.	(15.)	Grade roads to maintain drainage	(IE1)
8.	(18.)	Skidding operation minimizes soil displacement	(IIC1a)
9.	(12.)	Avoid equipment operations in wetlands	(IIB3b)
10	(2.)	Prevent erosion of culvert and bridge fill	(IIIC3)
11.	(8.)	Minimize equipment operation in SMZ	(IIB3a)
12.	(-)	Cut and fill slopes at stable angles	(ID5)
13.	(19.)	Adjust road grades to reduce concentration of water	(IIIB1b)
14.	(13.)	Minimize compaction and displacement of soil	(IID5)
15.	(4.)	Stabilize erodible soils (seeding)	(ID2)
16.	(-)	Adequate roadside SMZ	(IA5)
17.	(-)	Restrict road use when wet	(IE6)
18.	(-)	Dozer operations on suitable slopes	(IID6)

These 18 practices accounted for 73% of all departures and 66% of all impacts. The remaining BMPs had a lower frequency of departures in application or resultant impacts.

The following practices were on the 1990 list of BMPs most often not applied or resulting in impacts but did not make the list in 1992. The number in parenthesis on the left is the ranking from the 1990 report.

(5.) Install slash filter windrows (ID3).
(7.) Streams free of logging debris (IIB4).
(10.) Erosion control features (ditches and culverts) functional (IE2).
(14.) Culverts conform to natural streambed and slope (IIIC2).
(17.) Vary road grade for drainage (IB4).

On the positive side, BMPs that were nearly always properly applied, resulting in few impacts (three or fewer minor temporary impacts), include:

- Most BMPs related to road planning and location (IA).
- Skew ditch relief culverts (IC2).
- Energy dissipators at CMP outlets (IC4).
- Overburden placed to avoid entering streams (ID8).
- Avoid cutting the toe of cut slopes (IE3).
- Suitable location, size, & number of landings (IIA6).
- Keep openings under 600 feet along channel (IIB2c).
- Brush blades used on dozers (IID2).
- Skidding operation minimizes compaction (IIC1b).
- Adequate drainage for landings (IIC2b).
- Get proper permits for stream crossings (IIIA1).
- Cross streams at right angles if practical (IIIB1a).
- Minimize stream channel disturbance (IIIC1).
- Adequate storage and disposal for fuel, waste oil (VA2).

Logging contractors attended 12 out of the 46 audits. Team members felt it was beneficial for all if contractors attended.

Audit team members noticed a range of potential or actual water quality impacts that are not reflected in the results. In some cases, other land uses in the vicinity of the audits were noted as potential impacts. These other land uses include grazing, mining and subdivision development. In some cases, road erosion problems were noted as potential impacts. These other land uses include grazing, mining and subdivision development. In some cases, road erosion problems were noted outside of the BMP audit area. When possible, team members notified landowners of these situations.

Three non-industrial sites had a pre-harvest visit under the BMP notification law. Pre-harvest visits are limited to high risk sites. In application of BMPs, one of these sites had 26 departures, one had 21 departures and one had 8. The average number of departures on all sites was 5.6. See Table 5.

Streamside Management Zones

Audit teams collected information on the number of stream crossings on the sites and the width of the Streamside Management Zone delineated for the harvest site. Where a range of values was given for SMZ width, the mean value was used.

Table 9

Number of Stream Crossings and Width of SMZs on Audited Sites

Ownership Group	# of Stream Crossings			Width of SMZs in feet		
	Min.	Max.	Ave.	Min.	Max.	Ave.
Federal	0	6	1.9	0	150	44
Industrial	0	6	2.1	20	105	55
NIP	0	3	1.0	0	200	53
State	0	3	1.6	20	100	83
All Sites	0	6	1.7	0	200	53

Table 10 shows the effectiveness of BMPs applied in the SMZ with respect to the width of the SMZ. Sites with wider SMZs resulted in fewer impacts from harvest practices within the SMZ.

Table 10

Effectiveness of SMZ-BMPs by SMZ Width

SMZ Width	Percent (%) Rated As				
	# of Sites	Adequate Protection	Minor/Temp	Major/Temp, Minor/Prolong	Major/Prolong
< 25 ft.	5	47%	13%	16%	24%
25-50 ft.	25	92%	7%	1%	0%
> 50 ft.	16	96%	4%	0%	0%
Overall	46	88%	7%	2%	3%

Results by Ownership Group and Geographic Area

There are notable differences among the ownership groups in their application and effectiveness of all BMPs. State lands had a higher rating than the other ownership groups, although the desired number of high hazard sites were not available. Results from Federal (USFS and BLM) and industrial sites were similar and ranked second among the ownership groups. Non-industrial private ranked last. See Figure 2. Non-industrial private lands eshibited the highest average number of departures per site. Six of the nine sites on non-industrial private lands had major or prolonged impacts (an effectiveness rating less than 3.)

There appears to be no notable differences among regions of the State in application and effectiveness of BMPs.

Comparison with Previous Audits

The 1992 audits were conducted in a manner directly comparable to the 1990 audits. The same selection criteria and rating format were used. Most audit team members had participated in the 1990 audits. Earlier audits, conducted in 1988 and 1989 were similar, but had some differences in design and content. The most accurate comparison is between the 1990 and 1992 audits.

The 1992 audits show improvement in the application and effectiveness of BMPs for all ownership groups when compared with the 1990 results. See Table 11 for a comparison of the 1990 and 1992 results.

Table 11

Comparison of BMP Audit Results: 1992 vs. 1990

	1992	1990
Application of practices that meet or exceed BMP requirements	87%	78%
Application of high risk practices that meet or exceed BMP requirements	72%	53%
Number of sites with at least one major departure in BMP application	20 of 46 (43%)	27 of 44 (61%)
Average number of departures in BMP application, per site	5.6	9
Number of practices providing adequate protection	90%	80%
Number of high risk practices providing adequate protection	77%	58%
Number of sites having at least one major temporary or minor prolonged impact.	17 of 46 (37%)	28 of 44 (64%)
Average number of impacts per site	4.6	8

Non-industrial private sites showed improvement over 1990, but still rank the lowest of all ownership groups. In 1990, NIP sites averaged 15 impacts per site. In 1992, NIP sites averaged 10 impacts per site. Minor temporary impacts were reduced, but there were more major prolonged impacts.

State lands was the only ownership group that had no major temporary or prolonged impacts on 1992. In 1990 7% of BMPs on state sites were rated as major/ temporary or minor/prolonged impacts.

In 1992, industrial lands had 6 sites with major temporary or minor prolonged impacts. In 1990 the count was 11. The same number of sites was visited each year.

In 1992, federal lands showed a small increase in percent of sites with minor temporary impacts but reduced percentage of sites with major temporary or minor prolonged impacts. Federal sites showed a decrease in the average number of impacts per site.

Figure 3 displays BMP application results for the four forestry BMP audits conducted in Montana.

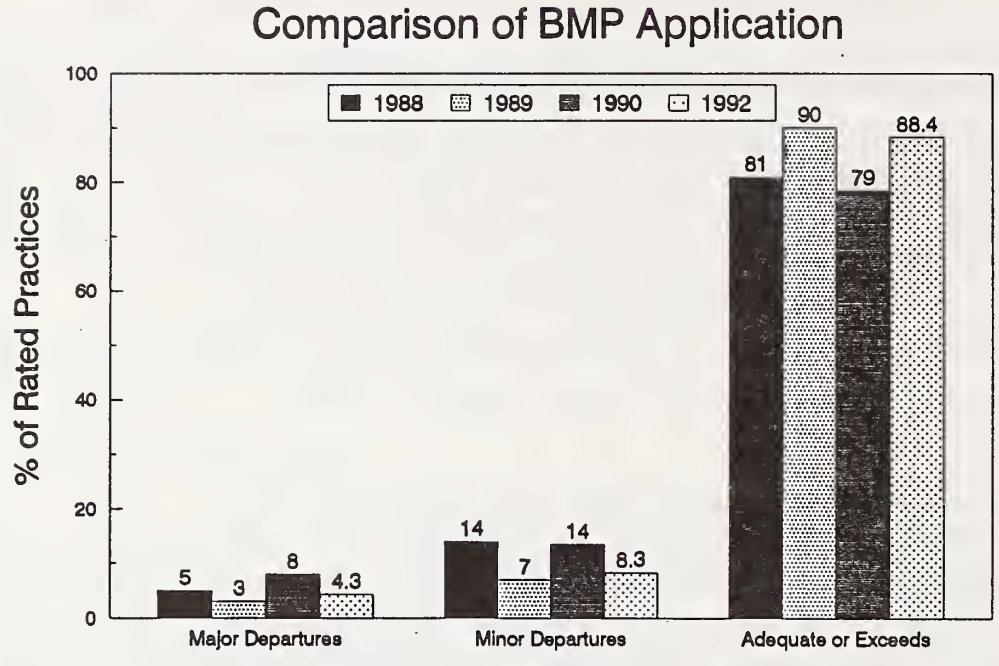


Figure 3.

Major departures are practices with an application rating < 3.
Minor departures are practices with an application rating of 3.
Adequate or exceeds are practices with an application rating > 3.

Figure 4 displays BMP effectiveness results for the four forestry BMP audits conducted in Montana.

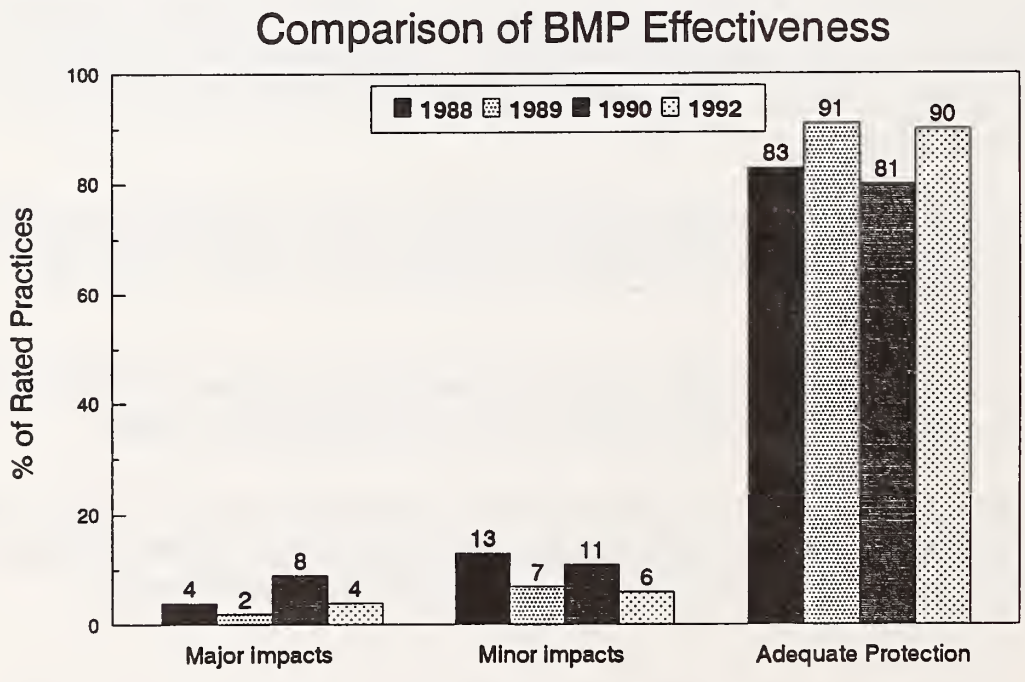


Figure 4.

Major impacts are practices with an effectiveness rating < 3.
Minor impacts are practices with an effectiveness rating of 3.
Adequate protection is a practice with an effectiveness rating > 3.

The 1992 audit ratings showed improvement over the 1990 ratings when one looks at the percent of sites with major departures or impacts, as in Figure 5.

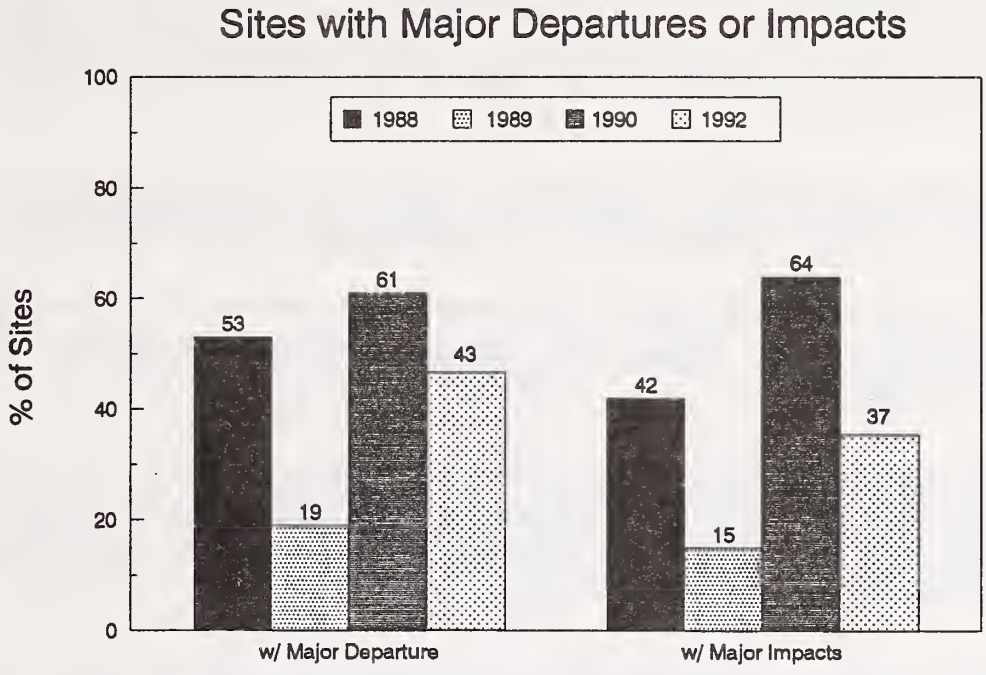


Figure 5. Major departures are practices with an application rating of 1 or 2.

The 1992 audits had fewer major impacts per site than the 1990 audits did. See Figure 6. Impacts per site are expressed as a percentage of rated practices per site, in order to account for differences in the average number of rated practices per site between study years.

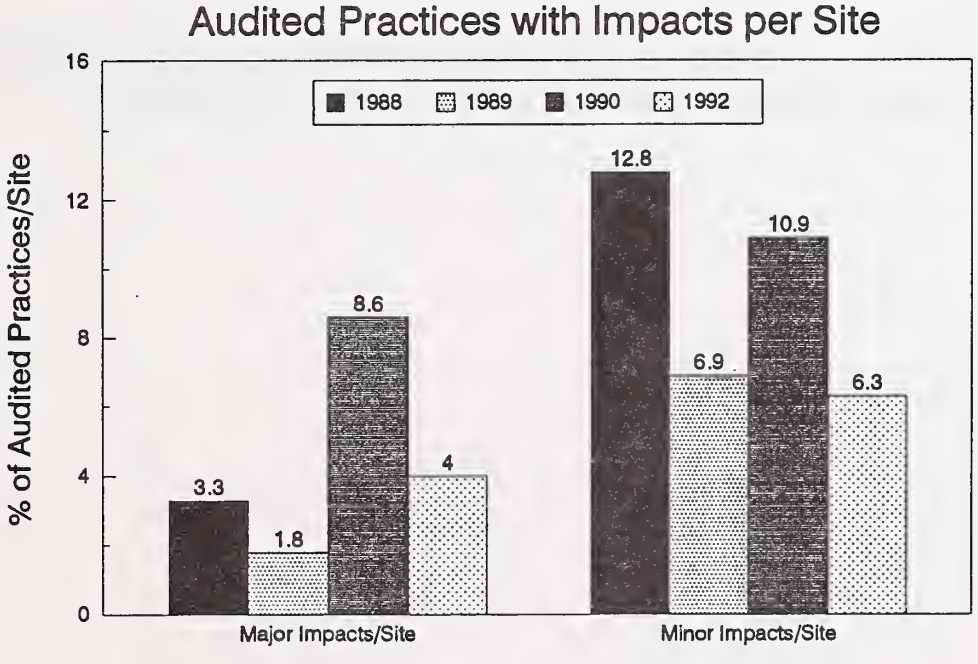


Figure 6. Major impacts are practices with an effectiveness rating of < 3.
Minor impacts are practices with an effectiveness rating of 3.

RECOMMENDATIONS FROM AUDIT TEAM MEMBERS

- Continue the interdisciplinary forestry BMP audits, whether under a non-regulatory or regulatory program. The audit process has been fundamental in educating and making people aware of BMP requirements. Conduct the audits every two years.

- Update the rating form. Adjust for the Streamside Management Act, and for recommended improvements to the rating guide and practices listed.

- Continue educating loggers, landowners, and foresters, concentrating on problem areas documented through BMP audits. Concentrate educational efforts on NIP landowners.

- Actively encourage the sites' owners and logging contractors to attend the audit. The Montana Logging Association and the Montana Wood Products Association will assist DSL in notifying contractors. At a minimum, give contractors a copy of the audit results for their sites.

- The team leader should encourage the landowner and contractor, and if needed in the case of NIP lands, the DSL Service Forester, to develop a remedy for problems noted. An audit team member will assist if necessary, especially to identify problems. Industry groups, such as MLA and MWPA may participate as needed.

- Continue funding volunteer audit team members.

- Institute a similar BMP audit process for other land uses, including mining, livestock grazing, agriculture and subdivision development.

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APPENDIX A

6/92

1992 BMP FIELD AUDITS

BMP AUDIT TEAM MEMBERS

EXPERTISE	AUDIT TEAM		
	NORTHWEST	WEST CENTRAL	SOUTHWEST/EAST
Fisheries	+S. Rumsey, DFWP	+D. Workman, DFWP	+G. Phillips, DFWP
	(+T. Weaver, DFWP)	(+C. Clancey, DFWP)	(J. Brammer, DFWP)
	or (+M. Enk, USFS)	or (+D. Peters, DFWP)	
Hydrology	+B. Putnam, USFS	+B. Schultz, DSL	+S. Tralles, WQB
	(J. Schumaker, DNRC)	(+G. Frank, DSL)	(W. Kellogg, WQB)
Soils	+J. Collins, DSL	+B. Dutton, PVT	+V. Ciliberti, BLM
	(+T. Wiersum, SCS)	(+T. Wiersum, SCS)	(M. Browne, BLM)
Forestry	+R. Hudson, PVT	+G. Sanders, CIC	+S. Flynn, LP
	(V. Anderson, PCTC)	(+P. Davis, PCTC)	(R. Franke, LP)
Eng./Roads	F. McCubbins, Stoltze	+Joel Marshik, USFS	+D. Wick, PCTC
	(+J. Okonski, Private)	(Jim Saubier, USFS)	(S. Anderson, Cont.)
Conservation	+Don Alley	+B. Benson, CFC	+P. Hackley, EIC
	(+R. Ash, Audub.)	(B. Farling, CFC)	(+C. Jones, EIC)

Legend:

REDLINE denotes Team Leader.

( ) denotes alternate.

+ denotes prior BMP audit team experience.

1992 BMP FIELD AUDITS
RISK RATING GUIDE

MONTANA "RISK" MATRIX (3/91)

TYPE		CLEARCUT				PARTIAL CUT				SITE PREP			ROADS	
SLOPE	SOIL EROD.	TRACKED EQUIP.	RUBBER SKID	PARTIAL SUSP.	FULL SUSP.	TRACKED EQUIP.	RUBBER SKID	PARTIAL SUSP.	FULL SUSP.	MACHINE PILE/SCAR	BRDCAST BURN	OTHER	PERM.	TEMP.
0-5%	H	2	2	2	1	2**	2**	1	1	2	1	1	2**	3
	M	2	1	1	1**	2	1**	1	1	2**	1	1	1	1
	L	1	1	1	1	1	1	1	1	1	1	1	1	1
5-20%	H	4	3	2	1	4*	3	2	1	4	2	1	3	4
	M	3	2	1	1	3*	2	1	1	3	2	1	2	3
	L	2	2	1	1	2*	2*	1	1	2	1	1	2	2
20-40%	H	5	5	4*	2	5*	5*	3**	1	5	3**	1	4	5
	M	4*	4	3	1	3	3	2	1	4	3	1	3	4*
	L	3*	2	2	1	2	2	2	1	3	2	1	3*	3
> 40%	H	5	5	4	2	5	5	4	2	5	4	1	5	5
	M	5	5	4	2*	5	5	3	1	5	4	1	5	5
	L	4	4	3	1	4	4	2	1	4	3*	1	4	4

(* Indicates Mean Value Used, ** Final Group Consensus Adjustment for Internal Consistency)

MONTANA EROSION-IMPACT MATRIX

From: "Management Guidelines For Riparian Forests" by Robert Pfister and Kim Sherwood. Flathead Basin Forest Practices Water Quality and Fisheries Cooperative Program.

LEGEND
1 = LOW RISK
2-3 = MODERATE RISK
4-5 = HIGH RISK

SOIL ERODIBILITY

HIGH ERODIBILITY	MODERATE ERODIBILITY	LOW ERODIBILITY
GRANITICS	SCHIST	ARGILLITE/QUARTZITE
ALLUVIUM	SOFT/HARD SEDIMENTS	METAMORPHIC (BELT)
LACUSTRINE	BASIC IGNEOUS	

HIGH RISK DUE TO RIPARIAN HARVEST

"HIGH" risk will be assigned to sales with logging in riparian zones along streams. Riparian zones are located between aquatic and terrestrial environments and are identified by distinct vegetation that requires or tolerates free or unbound water. This includes but is not limited to the following habitat types: ABLA/CACA, (all phases), ABLA/OPHO, PICEA/EQAR, THPL/OPHO.

APPENDIX C

MONTANA FOREST PRACTICES REVIEW WORKSHEET

DATE: _____ OWNER: _____

HRA #: _____ CONTRACTOR: _____

LEGAL DESCRIPTION: _____

DRAINAGE: _____

SALE NAME: _____

GEOLOGY & SOILS: _____

_____

SLOPE RANGE: _____

PRACTICES

STAGE: (X IF COMPLETED) PREHARVEST ( ) ROAD CONSTRUCTION ( )
HARVEST ( ) SLASH DISPOSAL ( )

ROADS: NEW CONSTRUCTION (LENGTH): _____

RECONSTRUCTION (LENGTH): _____

HARVEST: CLEARCUT _____ SEEDTREE _____
(ACRES & METHOD) OSR _____ SHELTERWOOD _____

IND. SELECTION _____

SITE PREPARATION: _____

SLASH DISPOSAL: _____

RATING GUIDE

APPLICATION
5--OPERATION EXCEEDS REQUIREMENTS OF BMP
4--OPERATION MEETS REQUIREMENTS OF BMP
3--MINOR DEPARTURE FROM BMP
2--MAJOR DEPARTURE FROM BMP
1--GROSS NEGLECT OF BMP

EFFECTIVENESS
5--IMPROVED PROTECTION OF SOIL AND WATER RESOURCES OVER PRE-PROJECT CONDITION
4--ADEQUATE PROTECTION OF SOIL AND WATER RESOURCES
3--MINOR AND TEMPORARY IMPACTS ON SOIL & WATER RESOURCES
2--MAJOR AND TEMPORARY OR MINOR AND PROLONGED IMPACTS ON SOIL AND WATER RESOURCES.
1--MAJOR AND PROLONGED IMPACTS ON SOIL AND WATER RESOURCES.

DEFINITIONS (BY EXAMPLE):
ADEQUATE--SMALL AMOUNT OF MATERIAL ERODED; MATERIAL DOES NOT REACH DRAWS, CHANNELS, OR FLOODPLAIN.
MINOR--EROSION AND DELIVERY OF MATERIAL TO DRAWS BUT NOT STREAM.
MAJOR--EROSION AND SUBSEQUENT DELIVERY OF SEDIMENT TO STREAM OR ANNUAL FLOODPLAIN.
TEMPORARY--IMPACTS LASTING ONE YEAR OR LESS; NO MORE THAN ONE RUNOFF SEASON.
PROLONGED--IMPACTS LASTING MORE THAN ONE YEAR.

NR--NOT REVIEWED
NA--NOT APPLICABLE

RECOMMENDED BEST MANAGEMENT PRACTICES	APPLICABLE TO SITE (Y/N)	APPLICATION	EFFECTIVENESS	COMMENTS
ROADS				
ROAD PLANNING & LOCATION--SECTION I.A.				
1a. MINIMIZE NUMBER OF ROADS NECESSARY.				
1b. USE EXISTING ROADS UNLESS AGGRAVATE EROSION.				
3a. FIT ROAD TO THE TOPOGRAPHY.				
3b. AVOID LONG, SUSTAINED, STEEP ROAD GRADES.				
4. LOCATIONS AVOID HIGH HAZARD SITES.				
5. ADEQUATE SMZ BETWEEN ROAD AND STREAM CHANNELS.				
6. MINIMIZE NUMBER OF STREAM CROSSINGS. NUMBER _____.				

I.D. _____

RECOMMENDED BEST MANAGEMENT PRACTICES	APPLICABLE TO SITE (Y/N)	APPLICATION	EFFECTIVENESS	COMMENTS
ROAD DESIGN--SECTION I.B.				
2. DESIGN ROADS TO MINIMUM STANDARD NECESSARY.				
4. VARY ROAD GRADE FOR DRAINAGE.				
5. PROPER SIZING FOR CROSSING STRUCTURES.				
DRAINAGE FROM ROAD SURFACE SECTION I.C.				
1. PROVIDE ADEQUATE ROAD SURFACE DRAINAGE.				
2. SKEW DITCH RELIEF CULVERTS.				
4. PROVIDE ENERGY DISSIPATORS AT CMP OUTLETS WHERE NEEDED.				
6. ROUTE ROAD DRAINAGE THROUGH SMZ.				
CONSTRUCTION--SECTION I.D.				
1. EROSION CONTROL WORK CURRENT WITH CONSTRUCTION.				
2. STABILIZE ERODIBLE SOILS (SEEDING).				
3. SLASH FILTER WINDROWS INSTALLED.				
5. CUT AND FILL SLOPES AT STABLE ANGLES. SLOPE RATIO: _____.				
6. CLEAR VEGETATION BEFORE CONSTRUCTION.				
8. OVERBURDEN PLACED TO AVOID ENTERING STREAM.				
9. SEDIMENT FROM BORROW PITS MINIMIZED.				
10. RECONSTRUCT ONLY TO THE EXTENT NECESSARY.				
ROAD MAINTENANCE--SECTION I.E.				
1. GRADE ROADS TO MAINTAIN DRAINAGE.				
2. EROSION CONTROL FEATURES (DITCHES AND CULVERTS) FUNCTIONAL.				
3. AVOID CUTTING THE TOE OF CUT SLOPES.				
6. RESTRICT USE OF ROADS DURING WET PERIODS AND SPRING BREAKUP.				
8. ABANDONED ROADS IN CONDITION TO PROVIDE ADEQUATE DRAINAGE.				

I.D. _____

RECOMMENDED BEST MANAGEMENT PRACTICES	APPLICABLE TO SITE (Y/N)	APPLICATION	EFFECTIVENESS	COMMENTS
TIMBER HARVESTING HARVEST DESIGN--SECTION II.A.				
2. SUITABLE LOGGING SYSTEM FOR TOPOGRAPHY.				
5. SKID TRAIL DESIGN AVOIDS CONCENTRATING RUNOFF.				
6. SUITABLE LOCATION, SIZE, AND NUMBER OF LANDINGS.				
STREAMSIDE MANAGEMENT--SECTION II.B.				
1. ADEQUATE SMZ MAINTAINED (WIDTH _____).				
2a. VEGETATION MAINTAINED ALONG STREAM.				
2b. RETAIN TREES FOR STABILIZATION.				
2c. OPENINGS UNDER 600 FT. ALONG CHANNEL.				
3a. EQUIPMENT OPERATION MINIMIZED IN SMZ.				
3b. AVOID EQUIPMENT OPERATION IN WETLANDS.				
3c. AVOID EQUIPMENT OPERATION IN STREAM CHANNELS.				
4. STREAMS FREE OF LOGGING DEBRIS.				
OTHER HARVESTING ACTIVITIES SECTION II.C.				
1a. SKIDDING OPERATION MINIMIZES SOIL DISPLACEMENT.				
1b. SKIDDING OPERATION MINIMIZES COMPACTION.				
2a. ADEQUATE DRAINAGE FOR TEMPORARY ROADS, SKID TRAILS AND FIRE LINES.				
2b. ADEQUATE DRAINAGE FOR LANDINGS.				
SLASH TREATMENT AND SITE PREPARATION SECTION II.D.				
2. BRUSH BLADES USED ON DOZERS.				
4. SCARIFY ONLY TO THE EXTENT NECESSARY.				
5. COMPACTION AND DISPLACEMENT MINIMIZED.				
6. DOZER OPERATIONS ON SUITABLE SLOPES ONLY.				
9. LIMIT WATER QUALITY IMPACT OF PRESCRIBED FIRE.				

I.D. _____

RECOMMENDED BEST MANAGEMENT PRACTICES	APPLICABLE TO SITE (Y/N)	APPLICATION	EFFECTIVENESS	COMMENTS
STREAM CROSSINGS				
LEGAL REQUIREMENTS--SECTION III.A.				
1. PROPER PERMITS FOR STREAM CROSSINGS.				
DESIGN CONSIDERATIONS--SECTION III.B.				
1a. CROSS STREAMS AT RIGHT ANGLES. IF PRACTICAL.				
1b. ADJUST ROAD GRADES TO REDUCE CONCENTRATION OF WATER.				
2. AVOID UNIMPROVED STREAM CROSSINGS.				
INSTALLATION OF STREAM CROSSINGS SECTION III.C.				
1. MINIMIZE STREAM CHANNEL DISTURBANCE.				
2. CULVERTS CONFORM TO NATURAL STREAMBED AND SLOPE.				
3. PREVENT EROSION OF CULVERT AND BRIDGE FILLS.				
5. MINIMUM COVER FOR CULVERTS PROVIDED.				
HAZARDOUS SUBSTANCES GENERAL--SECTION V.A.				
1. COMPLY WITH REGULATION ON STORAGE, HANDLING, APPLICATION, AND DISPOSAL OF HAZARDOUS SUBSTANCES.				
2. ADEQUATE STORAGE AND DISPOSAL FOR FUEL, SHOP DEBRIS, AND WASTE OIL.				
PESTICIDES AND HERBICIDES SECTION V.B.				
1. PREVENT ENTRY OF HAZARDOUS SUBSTANCES INTO SURFACE WATERS.				
OTHER				**ADDITIONAL COMMENTS**

I.D. _____

SUPPLEMENTAL QUESTIONS
1990 BMP AUDITS

1. When roads were closed, or after use of temporary roads, were culverts or stream crossing structures removed and stream channel reformed to its pre-road configuration? (EPA #7A.)

2. What condition were temporary roads left in after their use? (EPA #7B.)

3. Would a change in stream crossing design have prevented any observed sediment discharge problems attributable to the crossings? Explain. (EPA #9A.)

4. Describe the width and depth of stream(s) associated with this sale. (EPA #12B.)

5. What length of streambank was left unshaded due to timber harvest and vegetation removal in the streamside zone? (EPA #13B.)

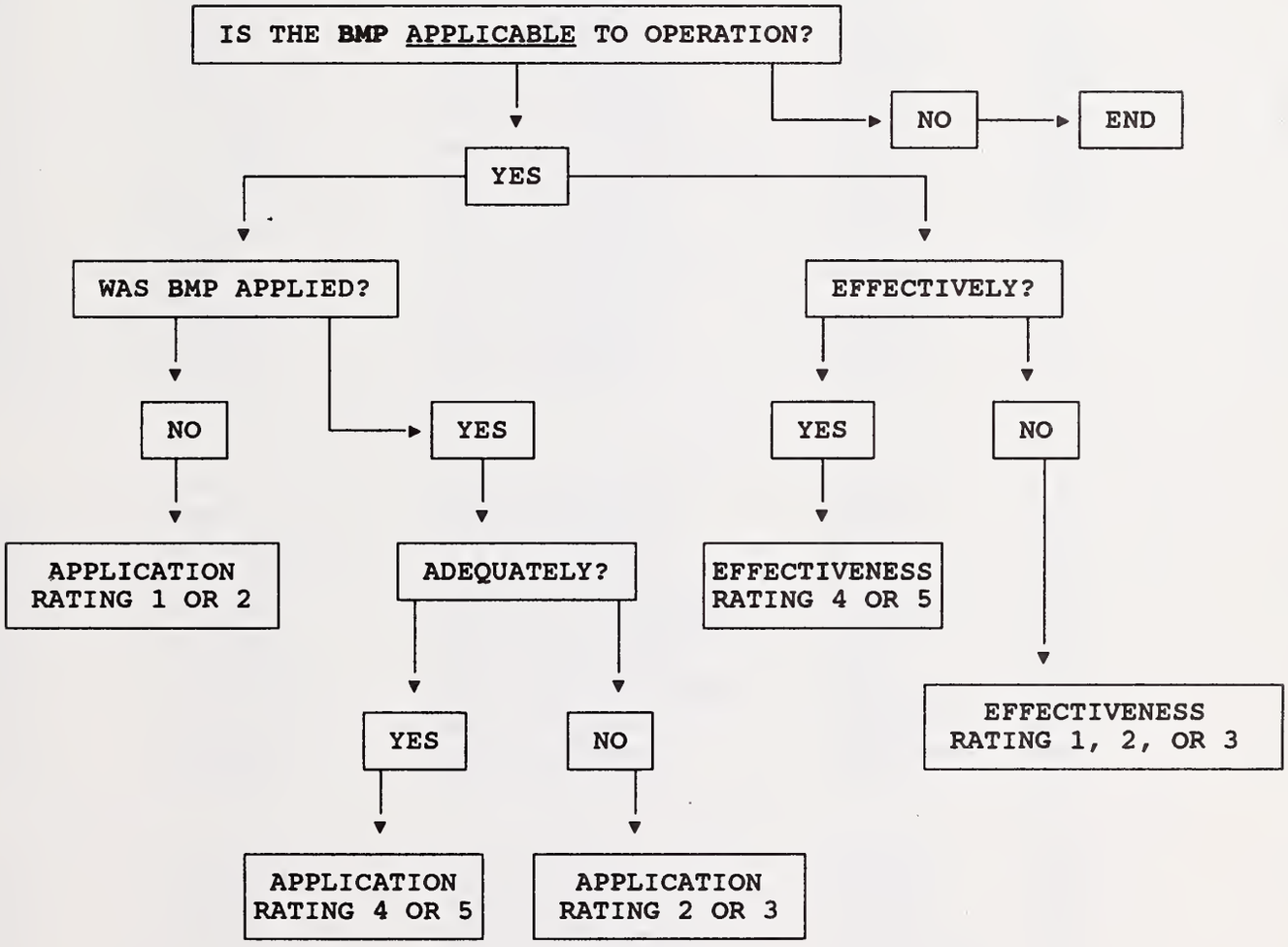
6. Did ground skidding take place through any perennial streams? (EPA #15A.)

7. Did timber harvest planning include considerations for watershed condition and cumulative effects of multiple timber management activities on water yield and sediment production? (EPA #21A.)

APPENDIX D

RATIONALE FOR THE RATING SYSTEM

POST HARVEST EVALUATION



APPENDIX E

1992 BMP FIELD AUDITS

SITES PICKED FOR AUDITS BY OWNERSHIP GROUP

Number	Sale Name	Location	County	Owner	Team
DSL-1	Burke Creek	Sec. 36, T15N-R3W	Lewis & Clark	DSL	SW
DSL-2	Butler Creek	Sec. 24, T16N-R23W	Missoula	DSL	WC
DSL-3	Round Meadow	Sec. 8, T33N-R23W	Flathead	DSL	NW
DSL-4	Lower Stillwater Lk. W. #2	Sec. 7, 18, T32N-R23W	Flathead	DSL	NW
DSL-5	Gobbler's Knob	Sec. 16, T27N-R26W	Flathead	DSL	NW
IND-1	Sumor Flatheads	Sec. 21, T3N-R6E	Gallatin	P.C.	SW
IND-2	Battle 9 Tractor	Sec. 9, T1N-R7E	Gallatin	P.C.	SW
IND-3	Cathouse Cr.	Sec. 9, T3N-R19W	Ravalli	DL	WC
IND-4	Haskill Gate	Sec. 9, T31N-R21W	Flathead	Stol.	NW
IND-5	Old Mill Site	Sec. 32, T28N-R25W	Flathead	Champ.	NW
IND-6	Rock Cr. Cat	Sec. 28, T31N-R26W	Lincoln	Champ.	NW
IND-7	Cow's Bottom	Sec. 5, 6, T28N-R28W	Lincoln	Champ.	NW
IND-8	S. Blanchard	Sec. 25, T15N-R16W	Missoula	Champ.	WC
IND-9	E. F. Ashby	Sec. 11, 12, 13, T12N-R16W	Missoula	Champ.	WC
IND-10	Work Center Line	Sec. 19, T12N-R22W	Missoula	Champ.	WC
IND-11	Hemlock Pt.	Sec. 33, T20N-R17W	Missoula	PC	WC
IND-12	Elbow	Sec. 22, 27, T19N-R17W	Missoula	PC	WC
IND-13	Elk Mountain	Sec. 7, T11N-R17W	Missoula	PC	WC
IND-14	Baldy 15	Sec. 15, T26N-R21W	Flathead	PC	NW
IND-15	Barnum LPP	Sec. 2, T27N-R27W	Lincoln	PC	NW
IND-16	Mullan Pass	Sec. 23, T10N-R6W	Powell	PC	SW
NIP-1	Silverthorn Cr.	Sec. 31, 32, T9N-R20W	Ravalli	NIP	WC
NIP-2	Swamp Cr.	Sec. 13, T25N-R32W	Sanders	NIP	WC
NIP-3	Clark Fork Bench	Sec. 27, T27N-R34W	Sanders	NIP	WC
NIP-4	McDonald Cr.	Sec. 34, T10N-R9W	Powell	NIP	SW
NIP-5	Mule Creek	Sec. 21, 22, T29N-R14W	Flathead	NIP	NW
NIP-6	Noisy Creek	Sec. 26, 27, T28N-R19W	Flathead	NIP	NW
NIP-7	Big Lodge Cr.	Sec. 13, T25N-R21W	Lake	NIP	NW
NIP-8	Rocker Gulch	Sec. 3, 10, 11, T7N-R8W	Powell	NIP	SW
NIP-9	Guicici Cow	Sec. 15, T8S-R7W	Beaverhead	NIP	SW
NIP-10	Arrow Creek	Sec. 22, T19N-R9E	Judith Basin	NIP	SW
NIP-11	Spring Cr.	Sec. 35, T13N-R19E	Fergus	NIP	SW
FED-1	China Yankee	Sec. 6, T4S-R5E	Gallatin	USFS	SW
FED-2	Portal Salvage	Sec. 20, T6S-R5E	Gallatin	USFS	SW
FED-3	Stoner Cr.	Sec. 32, T27N-R21W	Flathead	USFS	NW
FED-4	Lion Whelp	Sec. 23, T30N-R19W	Flathead	USFS	NW
FED-5	American Gulch	Sec. 10, 11, T11N-R6W	Lewis & Clark	BLM	SW
FED-6	Yank Swamp	Sec. 24, T3S-R17W	Beaverhead	BLM	SW
FED-7	Lower Larry	Sec. 19, T33N-R29W	Lincoln	USFS	NW
FED-8	Hold-Up Gulch	Sec. 9, T35N-R28W	Lincoln	USFS	NW
FED-9	Sanders Face	Sec. 2, T29N-R26W	Lincoln	USFS	NW
FED-10	Lookout Below	Sec. 1, T29N-R34W	Lincoln	USFS	NW
FED-11	Treasure Mtn.	Sec. 15, T8N-R6W	Powell	USFS	SW
FED-12	Odouir	Sec. 29, T11N-R10E	Meagher	USFS	SW
FED-13	Chippy Cr.	Sec. 29, T24N-R25W	Sanders	USFS	WC
FED-14	Lairdon Gulch	Sec. 14, T4N-R20W	Ravalli	USFS	WC
FED-15	W.F. Swartz Cr.	Sec. 13, T11N-R18W	Missoula	USFS	WC
FED-16	Alpine Divide	Sec. 19, T17N-R24W	Missoula	USFS	WC

APPENDIX F

1992 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

Practice	Owner	APPLICATION 1	2	3	4	5	NR	EFFECTIVENESS 1	2	3	4	5	NR
ROAD PLANNING													
Minimize # of Roads I.A.1a	DSL	0	0	0	5	0	0	0	0	0	5	0	0
	FED	0	0	0	16	0	0	0	0	0	16	0	0
	IND	0	0	0	15	0	1	0	0	0	15	0	1
	NIP	0	0	0	8	0	1	0	0	0	8	0	1
	Total:	0	0	0	44	0	2	0	0	0	44	0	2
Use Existing Roads I.A.1b	DSL	0	0	0	4	0	1	0	0	0	4	0	1
	FED	0	0	0	16	0	0	0	0	0	16	0	0
	IND	0	0	1	13	0	2	0	0	1	13	0	2
	NIP	0	1	0	5	0	3	0	1	0	5	0	3
	Total:	0	1	1	38	0	6	0	1	1	38	0	6
Fit Road to Topography I.A.3a	DSL	0	0	0	5	0	0	0	0	0	5	0	0
	FED	0	0	0	15	0	1	0	0	0	15	0	1
	IND	0	0	1	14	0	1	0	0	0	15	0	1
	NIP	0	0	1	5	0	3	0	1	0	5	0	3
	Total:	0	0	2	39	0	5	0	1	0	40	0	5
Avoid Long, Steep Grades I.A.3b	DSL	0	0	0	5	0	0	0	0	0	5	0	0
	FED	0	0	0	15	0	1	0	0	0	15	0	1
	IND	0	0	0	14	0	2	0	0	0	14	0	2
	NIP	0	0	0	5	0	4	0	0	0	5	0	4
	Total:	0	0	0	39	0	7	0	0	0	39	0	7
Avoid High Hazard Areas I.A.4	DSL	0	0	0	5	0	0	0	0	0	5	0	0
	FED	0	0	0	14	0	2	0	0	0	14	0	2
	IND	0	0	1	14	0	1	0	0	1	14	0	1
	NIP	0	2	0	4	0	3	0	2	0	4	0	3
	Total:	0	2	1	37	0	6	0	2	1	37	0	6
Adequate SMZ Planned I.A.5	DSL	0	0	0	5	0	0	0	0	0	5	0	0
	FED	0	0	3	10	0	3	0	0	2	11	0	3
	IND	0	0	0	15	0	1	0	0	0	15	0	1
	NIP	0	2	1	3	0	3	0	1	1	4	0	3
	Total:	0	2	4	33	0	7	0	1	3	35	0	7

1992 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

Practice	Owner	APPLICATION 1	2	3	4	5	NR	EFFECTIVENESS 1	2	3	4	5	NR
Minimize # of	DSL	0	0	0	4	0	1	0	0	0	4	0	1
Stream X'ings	FED	0	0	0	15	0	1	0	0	0	15	0	1
I.A.6	IND	0	0	0	13	0	3	1	0	0	12	0	3
	NIP	0	0	0	5	0	4	0	0	0	5	0	4
	Total:	0	0	0	37	0	9	1	0	0	36	0	9
ROAD DESIGN													
Minimum Design	DSL	0	0	0	5	0	0	0	0	0	5	0	0
Standards	FED	0	0	0	14	0	2	0	0	0	14	0	2
I.B.2	IND	0	0	1	14	0	1	0	1	0	14	0	1
	NIP	0	0	0	5	0	4	0	0	0	5	0	4
	Total:	0	0	1	38	0	7	0	1	0	38	0	7
Vary Grade	DSL	0	0	0	5	0	0	0	0	0	5	0	0
for Drainage	FED	0	0	0	14	0	2	0	0	0	14	0	2
I.B.4	IND	0	0	2	13	0	1	0	0	1	14	0	1
	NIP	0	1	0	4	0	4	0	0	1	4	0	4
	Total:	0	1	2	36	0	7	0	0	2	37	0	7
Crossings	DSL	0	0	0	3	0	2	0	0	0	3	0	2
Properly Sized	FED	0	0	0	13	0	3	0	0	0	13	0	3
I.B.5	IND	0	0	1	13	0	2	0	1	0	13	0	2
	NIP	0	2	1	3	0	3	0	2	1	3	0	3
	Total:	0	2	2	32	0	10	0	3	1	32	0	10
ROAD DRAINAGE													
Adequate Sur-	DSL	0	0	1	4	0	0	0	0	0	5	0	0
face Drainage	FED	0	3	2	10	0	1	0	2	1	12	0	1
I.C.1	IND	0	0	5	11	0	0	0	1	4	10	1	0
	NIP	2	2	1	3	0	1	1	2	2	3	0	1
	Total:	2	5	9	28	0	2	1	5	7	30	1	2
Skew Relief	DSL	0	0	1	0	0	4	0	0	0	1	0	4
Culverts	FED	0	0	0	6	0	10	0	0	0	6	0	10
I.C.2	IND	0	0	0	5	0	11	0	0	0	5	0	11
	NIP	0	0	0	0	0	9	0	0	0	0	0	9
	Total:	0	0	1	11	0	34	0	0	0	12	0	34

1992 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

		APPLICATION						EFFECTIVENESS					
Practice	Owner	1	2	3	4	5	NR	1	2	3	4	5	NR
Energy Dissip.	DSL	0	0	0	3	0	2	0	0	0	3	0	2
at CMP Outlets	FED	0	0	1	8	0	7	0	0	1	8	0	7
I.C.4	IND	0	0	0	12	0	4	0	0	0	12	0	4
	NIP	0	0	1	1	0	7	0	0	1	1	0	7
	Total:	0	0	2	24	0	20	0	0	2	24	0	20
Route Drainage	DSL	0	0	1	3	0	1	0	0	1	3	0	1
Through SMZ	FED	0	3	2	8	0	3	0	3	0	10	0	3
I.C.6	IND	0	4	3	8	0	1	0	3	3	9	0	1
	NIP	1	0	2	4	0	2	1	1	1	4	0	2
	Total:	1	7	8	23	0	7	1	7	5	26	0	7
ROAD CONSTRUCTION													
Erosion Control	DSL	0	0	1	3	0	1	0	0	0	4	0	1
Concurrent	FED	0	0	0	5	0	11	0	0	1	4	0	11
I.D.1	IND	0	0	0	10	0	6	0	0	0	10	0	6
	NIP	1	0	0	1	0	7	1	0	0	1	0	7
	Total:	1	0	1	19	0	25	1	0	1	19	0	25
Stabilize	DSL	0	0	0	5	0	0	0	0	0	5	0	0
Erodible Soils	FED	0	0	1	13	0	2	0	1	0	13	0	2
I.D.2	IND	0	0	2	13	0	1	0	0	3	12	0	1
	NIP	0	1	1	3	0	4	0	0	2	3	0	4
	Total:	0	1	4	34	0	7	0	1	5	33	0	7
Slash Filter	DSL	0	0	0	2	0	3	0	0	0	2	0	3
Windrows	FED	0	0	1	6	0	9	0	1	1	5	0	9
I.D.3	IND	0	1	1	7	0	7	0	1	1	7	0	7
	NIP	0	0	0	0	0	9	0	0	0	0	0	9
	Total:	0	1	2	15	0	28	0	2	2	14	0	28
Slopes at	DSL	0	0	0	4	0	1	0	0	0	4	0	1
Stable Angle	FED	0	0	3	11	1	1	0	0	3	12	0	1
I.D.5	IND	0	0	1	15	0	0	0	0	2	14	0	0
	NIP	0	1	1	4	0	3	0	0	2	4	0	3
	Total:	0	1	5	34	1	5	0	0	7	34	0	5

1992 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

		APPLICATION						EFFECTIVENESS					
Practice	Owner	1	2	3	4	5	NR	1	2	3	4	5	NR
Clear Veget.	DSL	0	0	0	4	0	1	0	0	0	4	0	1
Before Const.	FED	0	0	0	15	0	1	0	0	0	15	0	1
I.D.6	IND	0	0	0	15	0	1	0	0	0	15	0	1
	NIP	0	0	1	4	0	4	0	0	0	5	0	4
	Total:	0	0	1	38	0	7	0	0	0	39	0	7
Overburden	DSL	0	0	0	1	0	4	0	0	0	1	0	4
Placement	FED	0	0	1	6	0	9	0	0	1	6	0	9
I.D.8	IND	0	0	0	3	0	13	0	0	0	3	0	13
	NIP	0	0	0	0	0	9	0	0	0	0	0	9
	Total:	0	0	1	10	0	35	0	0	1	10	0	35
Sediment From	DSL	0	0	0	0	0	5	0	0	0	0	0	5
Borrow Pits	FED	0	0	1	6	0	9	0	0	0	7	0	9
I.D.9	IND	0	0	1	2	0	13	0	1	0	2	0	13
	NIP	0	0	0	2	0	7	0	0	0	2	0	7
	Total:	0	0	2	10	0	34	0	1	0	11	0	34
Minimize	DSL	0	0	0	4	0	1	0	0	0	4	0	1
Reconstruction	FED	0	0	0	10	0	6	0	0	0	10	0	6
I.D.10	IND	0	0	0	9	1	6	0	0	0	10	0	6
	NIP	0	1	0	4	0	4	0	1	0	4	0	4
	Total:	0	1	0	27	1	17	0	1	0	28	0	17
ROAD MAINTENANCE													
Grade Roads	DSL	0	0	0	5	0	0	0	0	1	4	0	0
for Drainage	FED	0	1	0	14	0	1	0	1	0	14	0	1
I.E.1	IND	0	0	3	13	0	0	0	0	1	15	0	0
	NIP	2	3	1	2	0	1	1	2	2	3	0	1
	Total:	2	4	4	34	0	2	1	3	4	36	0	2
Erosion Control	DSL	0	0	0	5	0	0	0	0	1	3	1	0
Functional	FED	0	0	4	12	0	0	0	0	2	14	0	0
I.E.2	IND	0	0	1	13	0	2	0	0	1	13	0	2
	NIP	0	0	0	5	0	4	0	0	0	5	0	4
	Total:	0	0	5	35	0	6	0	0	4	35	1	6

1992 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

		APPLICATION						EFFECTIVENESS					
Practice	Owner	1	2	3	4	5	NR	1	2	3	4	5	NR
Avoid Cutting	DSL	0	0	0	5	0	0	0	0	0	5	0	0
Slope Toe	FED	0	0	0	14	1	1	0	0	0	15	0	1
I.E.3	IND	0	0	2	14	0	0	0	0	1	15	0	0
	NIP	0	0	0	2	0	7	0	0	0	2	0	7
	Total:	0	0	2	35	1	8	0	0	1	37	0	8
Restrict Use	DSL	0	0	0	4	0	1	0	0	0	4	0	1
When Wet	FED	0	0	0	15	1	0	0	0	0	16	0	0
I.E.6	IND	0	1	1	14	0	0	0	0	2	14	0	0
	NIP	0	1	2	4	1	1	0	1	2	5	0	1
	Total:	0	2	3	37	2	2	0	1	4	39	0	2
Adequate Drain.	DSL	0	0	1	2	0	2	0	0	0	3	0	2
on Aband. Roads	FED	0	0	1	7	1	7	0	0	0	9	0	7
I.E.8	IND	0	0	0	5	1	10	0	0	1	5	0	10
	NIP	0	0	1	2	0	6	0	0	1	2	0	6
	Total:	0	0	3	16	2	25	0	0	2	19	0	25
HARVEST DESIGN													
Logging Suits	DSL	0	0	0	5	0	0	0	0	0	5	0	0
Topography	FED	0	1	0	15	0	0	1	0	0	15	0	0
II.A.2	IND	0	0	1	15	0	0	0	0	1	15	0	0
	NIP	0	1	0	8	0	0	0	1	1	7	0	0
	Total:	0	2	1	43	0	0	1	1	2	42	0	0
Skid Trail	DSL	0	0	0	4	0	1	0	0	0	4	0	1
Design	FED	0	1	4	9	0	2	0	1	1	12	0	2
II.A.5	IND	0	1	1	13	0	1	0	1	1	13	0	1
	NIP	0	5	0	4	0	0	0	4	0	5	0	0
	Total:	0	7	5	30	0	4	0	6	2	34	0	4
Landing Size	DSL	0	0	0	5	0	0	0	0	0	5	0	0
Location	FED	0	1	0	15	0	0	0	1	0	15	0	0
II.A.6	IND	0	0	1	15	0	0	0	0	1	15	0	0
	NIP	0	1	0	8	0	0	0	1	0	8	0	0
	Total:	0	2	1	43	0	0	0	2	1	43	0	0

1992 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

Practice	Owner	APPLICATION 1	2	3	4	5	NR	EFFECTIVENESS 1	2	3	4	5	NR
STREAMSIDE MANAGEMENT													
Adequate SMZ	DSL	0	0	0	3	2	0	0	0	0	5	0	0
Maintained	FED	1	0	5	10	0	0	1	1	1	13	0	0
II.B.1	IND	0	2	2	8	4	0	0	0	4	12	0	0
	NIP	3	0	1	5	0	0	2	1	1	5	0	0
	Total:	4	2	8	26	6	0	3	2	6	35	0	0
Stream Veget.	DSL	0	0	0	5	0	0	0	0	0	5	0	0
Maintained	FED	0	0	1	15	0	0	0	0	1	15	0	0
II.B.2a	IND	0	0	0	16	0	0	0	0	0	16	0	0
	NIP	0	1	1	7	0	0	0	1	1	7	0	0
	Total:	0	1	2	43	0	0	0	1	2	43	0	0
Retain Bank	DSL	0	0	0	5	0	0	0	0	0	5	0	0
Trees	FED	0	0	2	13	1	0	0	1	1	14	0	0
II.B.2b	IND	0	0	0	15	1	0	0	0	0	16	0	0
	NIP	0	0	1	8	0	0	0	0	1	8	0	0
	Total:	0	0	3	41	2	0	0	1	2	43	0	0
Stream Openings	DSL	0	0	0	3	0	2	0	0	0	3	0	2
<600 Feet	FED	0	0	2	13	0	1	0	0	2	13	0	1
II.B.2c	IND	0	0	0	13	0	3	0	0	0	13	0	3
	NIP	0	0	0	7	0	2	0	0	0	7	0	2
	Total:	0	0	2	36	0	8	0	0	2	36	0	8
Equip. Operation	DSL	0	0	0	4	0	1	0	0	0	4	0	1
Minimized in SMZ	FED	0	1	2	12	1	0	0	1	1	14	0	0
II.B.3a	IND	0	0	0	16	0	0	0	0	0	16	0	0
	NIP	3	1	0	5	0	0	2	1	1	5	0	0
	Total:	3	2	2	37	1	1	2	2	2	39	0	1
Equip. Operation	DSL	0	0	1	3	0	1	0	0	0	4	0	1
in Wetlands	FED	1	0	3	5	1	6	1	0	3	6	0	6
II.B.3b	IND	0	0	1	9	0	6	0	0	1	9	0	6
	NIP	2	0	1	2	0	4	1	1	0	3	0	4
	Total:	3	0	6	19	1	17	2	1	4	22	0	17

1992 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

Practice	Owner	APPLICATION 1	2	3	4	5	NR	EFFECTIVENESS 1	2	3	4	5	NR
Equip. Operation	DSL	0	0	0	4	0	1	0	0	0	4	0	1
in Streams	FED	0	0	1	15	0	0	0	0	0	16	0	0
II.B.3c	IND	0	0	0	16	0	0	0	0	0	16	0	0
	NIP	2	0	2	5	0	0	2	0	2	5	0	0
	Total:	2	0	3	40	0	1	2	0	2	41	0	1
Streams Free of	DSL	0	0	0	5	0	0	0	0	0	5	0	0
Logging Debris	FED	0	0	1	15	0	0	0	0	1	15	0	0
II.B.4	IND	0	0	1	15	0	0	0	0	0	16	0	0
	NIP	0	1	2	6	0	0	0	1	2	6	0	0
	Total:	0	1	4	41	0	0	0	1	3	42	0	0
OTHER HARVEST ACTIVITY													
Skid to Min.	DSL	0	0	0	5	0	0	0	0	0	5	0	0
Displacing Soil	FED	0	1	1	14	0	0	0	0	2	14	0	0
II.C.1a	IND	0	0	3	12	1	0	0	0	3	13	0	0
	NIP	0	1	3	5	0	0	0	1	3	5	0	0
	Total:	0	2	7	36	1	0	0	1	8	37	0	0
Skid to Min.	DSL	0	0	0	5	0	0	0	0	0	5	0	0
Compacting Soil	FED	0	0	1	15	0	0	0	0	1	15	0	0
II.C.1b	IND	0	0	0	15	1	0	0	0	0	16	0	0
	NIP	0	0	2	7	0	0	0	0	2	7	0	0
	Total:	0	0	3	42	1	0	0	0	3	43	0	0
Adequate Drain.	DSL	0	0	0	5	0	0	0	0	0	5	0	0
for Skid Trails	FED	0	1	6	9	0	0	0	2	2	12	0	0
II.C.2a	IND	0	1	4	10	0	1	0	1	3	11	0	1
	NIP	1	4	1	2	0	1	1	3	0	4	0	1
	Total:	1	6	11	26	0	2	1	6	5	32	0	2
Adequate Drain.	DSL	0	0	0	5	0	0	0	0	0	5	0	0
for Landings	FED	0	0	1	14	0	1	0	0	2	13	0	1
II.C.2b	IND	0	0	0	14	0	2	0	0	0	14	0	2
	NIP	0	0	1	7	0	1	0	0	1	7	0	1
	Total:	0	0	2	40	0	4	0	0	3	39	0	4

1992 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

Practice	Owner	APPLICATION 1	2	3	4	5	NR	EFFECTIVENESS 1	2	3	4	5	NR
SITE PREPARATION													
Brush Blades	DSL	0	0	0	2	0	3	0	0	0	2	0	3
Used	FED	0	0	0	8	0	8	0	0	0	8	0	8
II.D.2	IND	0	0	0	5	0	11	0	0	0	5	0	11
	NIP	0	0	0	4	0	5	0	0	0	4	0	5
	Total:	0	0	0	19	0	27	0	0	0	19	0	27
Scarify Only	DSL	0	0	0	4	0	1	0	0	0	4	0	1
to Extent	FED	0	0	0	13	0	3	0	0	0	13	0	3
Necessary	IND	0	0	0	11	0	5	0	0	0	11	0	5
II.D.4	NIP	1	0	1	3	0	4	1	0	1	3	0	4
	Total:	1	0	1	31	0	13	1	0	1	31	0	13
Compaction and	DSL	0	0	0	3	0	2	0	0	0	3	0	2
Displacement	FED	0	0	1	12	1	2	0	0	2	12	0	2
Minimized	IND	0	0	0	8	2	6	0	0	0	10	0	6
II.D.5	NIP	1	1	2	2	0	3	1	1	2	2	0	3
	Total:	1	1	3	25	3	13	1	1	4	27	0	13
Dozer Operation	DSL	0	0	0	3	0	2	0	0	0	3	0	2
on Suitable	FED	0	0	2	10	0	4	0	1	0	11	0	4
Slopes Only	IND	0	0	1	6	0	9	0	0	1	6	0	9
II.D.6	NIP	0	0	3	3	0	3	0	0	2	4	0	3
	Total:	0	0	6	22	0	18	0	1	3	24	0	18
Limit WQ Impact	DSL	0	0	0	4	0	1	0	0	0	4	0	1
of Fire	FED	0	1	1	11	0	3	0	0	2	11	0	3
II.D.9	IND	0	0	4	9	1	2	0	0	3	11	0	2
	NIP	1	0	4	2	0	2	0	2	2	3	0	2
	Total:	1	1	9	26	1	8	0	2	7	29	0	8
STREAM CROSSINGS													
Proper Permit	DSL	0	0	0	3	0	2	0	0	0	3	0	2
Obtained	FED	0	0	0	6	0	10	0	0	0	6	0	10
III.A.1	IND	0	0	0	5	0	11	0	0	0	5	0	11
	NIP	0	1	0	4	0	4	0	1	0	4	0	4
	Total:	0	1	0	18	0	27	0	1	0	18	0	27

1992 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

Practice	Owner	APPLICATION 1	2	3	4	5	NR	EFFECTIVENESS 1	2	3	4	5	NR
STREAM XING DESIGN													
Cross Stream	DSL	0	0	0	3	0	2	0	0	0	3	0	2
at Right Angle	FED	0	0	0	11	0	5	0	0	0	11	0	5
III.B.1a	IND	0	0	0	15	0	1	0	0	0	15	0	1
	NIP	0	0	0	7	0	2	0	0	0	7	0	2
	Total:	0	0	0	36	0	10	0	0	0	36	0	10
Reduce Concen.	DSL	0	0	0	3	0	2	0	0	0	3	0	2
of Runoff	FED	0	2	1	10	0	3	0	1	1	11	0	3
III.B.1b	IND	0	0	3	11	0	2	0	0	2	12	0	2
	NIP	1	0	0	4	0	4	1	0	0	4	0	4
	Total:	1	2	4	28	0	11	1	1	3	30	0	11
Avoid Unimproved	DSL	0	0	0	2	0	3	0	0	0	2	0	3
Crossings	FED	0	0	0	13	0	3	0	0	0	13	0	3
III.B.2	IND	0	0	1	11	1	3	0	0	1	12	0	3
	NIP	0	0	1	6	0	2	0	0	1	6	0	2
	Total:	0	0	2	32	1	11	0	0	2	33	0	11
STREAM XING INSTALLATION													
Min. Channel	DSL	0	0	0	3	0	2	0	0	0	3	0	2
Disturbance	FED	0	0	0	11	0	5	0	0	0	11	0	5
III.C.2	IND	0	0	0	14	0	2	0	0	0	14	0	2
	NIP	0	0	1	6	0	2	0	0	0	7	0	2
	Total:	0	0	1	34	0	11	0	0	0	35	0	11
Culverts Conform	DSL	0	0	1	2	0	2	0	0	0	3	0	2
to Streambed	FED	0	0	3	8	1	4	0	0	1	11	0	4
Slope	IND	0	0	0	15	0	1	0	0	0	15	0	1
III.C.2	NIP	0	1	0	5	0	3	0	1	0	5	0	3
	Total:	0	1	4	30	1	10	0	1	1	34	0	10
Prevent Fill	DSL	0	0	0	3	0	2	0	0	0	3	0	2
Erosion	FED	0	0	2	10	0	4	0	0	2	10	0	4
III.C.3	IND	0	1	2	12	0	1	0	1	3	11	0	1
	NIP	1	1	0	4	0	3	0	2	0	4	0	3
	Total:	1	2	4	29	0	10	0	3	5	28	0	10

1992 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

Practice	Owner	APPLICATION 1	2	3	4	5	NR	EFFECTIVENESS 1	2	3	4	5	NR
Adequate Cover	DSL	0	0	0	3	0	2	0	0	0	3	0	2
for Culverts	FED	0	0	1	11	0	4	0	0	0	12	0	4
III.C.5	IND	0	0	0	15	0	1	0	0	0	15	0	1
	NIP	0	0	3	3	0	3	0	0	2	4	0	3
	Total:	0	0	4	32	0	10	0	0	2	34	0	10
HAZARDOUS SUBSTANCES													
Comply With	DSL	0	0	0	0	0	5	0	0	0	0	0	5
Regulations	FED	0	0	0	0	0	16	0	0	0	0	0	16
V.A.1	IND	0	0	0	0	0	16	0	0	0	0	0	16
	NIP	0	0	0	0	0	9	0	0	0	0	0	9
	Total:	0	0	0	0	0	46	0	0	0	0	0	46
Proper Storage	DSL	0	0	0	5	0	0	0	0	0	5	0	0
and Disposal	FED	0	0	3	12	0	1	0	0	0	15	0	1
V.A.2	IND	0	0	0	16	0	0	0	0	0	16	0	0
	NIP	0	0	1	8	0	0	0	0	0	9	0	0
	Total:	0	0	4	41	0	1	0	0	0	45	0	1
Prevent Entry	DSL	0	0	0	0	0	5	0	0	0	0	0	5
into Streams	FED	0	0	0	0	0	16	0	0	0	0	0	16
V.B.1	IND	0	0	0	0	0	16	0	0	0	0	0	16
	NIP	0	0	0	0	0	9	0	0	0	0	0	9
	Total:	0	0	0	0	0	46	0	0	0	0	0	46
GRAND	TOTALS:	24	63	168	1749	25	639	19	64	128	1816	2	639

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